



**STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND
CONSERVATION
DIVISION OF SOLID WASTE MANAGEMENT**

**STANDARD OPERATING PROCEDURE
FOR THE
STATE REMEDIATION PROGRAM**

This SOP is an intra-departmental document intended to govern the internal management of the Department of Environment and Conservation. It is intended to provide guidance to Department staff so that laws and rules we implement can be applied consistently. It is not intended to affect rights, privileges, or procedures available to the public.

DIVISION OF SOLID WASTE MANAGEMENT
SOP FOR THE STATE REMEDIATION PROGRAM

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INTRODUCTION

The purpose of this Standard Operating Procedure guide is to provide a consolidated reference document for use in training and orientation of employees. This guide will also be a useful reference tool for more experienced employees. The SOP identifies the technical information and application requirements for the State Remediation Section, Division Of Solid Waste Management. This SOP delineates steps in the process, including responsible personnel, and approximate process milestones. Additional information includes statute and rule authorization, a process flow chart, and supporting documentation (when necessary).

SECTION 1. STATUTORY AND REGULATORY AUTHORITY FOR PROCESS

- 1.1 TENNESSEE REGULATORY AUTHORITY FOR PROCESS**
- 1.2 MEMORANDUM OF AGREEMENT (MOA) BETWEEN THE STATE OF TENNESSEE AND THE EPA (SECTION VII. D. UTILIZING ALTERNATIVE STATE AUTHORITIES - NON PERMITTED SITES (COMPLETE DIVISION M.O.A. IS IN APPENDIX 3.))**
- 1.3 AMENDMENT TO TCA 68.215-107 (PETROLEUM CLEAN-UP CRITERIA)**
- 1.4 MEMORANDUM OF AGREEMENT BETWEEN THE DIVISION OF SUPERFUND AND THE DIVISION OF SOLID WASTE MANAGEMENT'S STATE REMEDIATION PROGRAM**
- 1.4a MEMORANDUM OF UNDERSTANDING BETWEEN USEPA, REGION 4, WATER MANAGEMENT DIVISION OF UNDERGROUND STORAGE TANK SECTION (HAZARDOUS UNDERGROUND STORAGE TANKS) AND THE STATE REMEDIATION PROGRAM**

SECTION 1.1

TENNESSEE REGULATORY AUTHORITY

SECTION 1.1

TENNESSEE STATUTORY AND REGULATORY AUTHORITY FOR PROCESS

The Department has authority under Tennessee Code Annotated 68-212-111 (Hazardous Waste Management Act of 1977) and under Tennessee Code Annotated 68-211-112 (Tennessee Solid Waste Disposal Act) to require corrective action. Remediation Orders, Notices of Remediation for Hazardous Waste and Notices of Remediation for Solid Waste that originate from the State Remediation Program each reference these regulations..

SECTION 1.2

MEMORANDUM OF AGREEMENT BETWEEN STATE OF TENNESSEE AND EPA (SECTION VII. D. - UTILIZING ALTERNATIVE STATE AUTHORITIES (NON PERMITTED SITES))

***The Memorandum of Agreement between the State of Tennessee and EPA is not available on diskette, but the printed manuscript is available upon request by calling the Division of Solid Waste Management - State Remediation Program at 615-532-0853.**

SECTION 1.3.

AMENDMENT TO TCA 68.215.107 (PETROLEUM CLEAN-UP CRITERIA)

***A copy of the Amendment to TCA 68.215.107 is available upon request from the Division of Solid Waste Management's State Remediation Program.**

SECTION 1.4

MEMORANDUM OF AGREEMENT BETWEEN THE DIVISION OF SUPERFUND AND THE DIVISION OF SOLID WASTE MANAGEMENT'S STATE REMEDIATION PROGRAM

DSWM/DSF REMEDIATION INITIATIVES AND SITE MANAGEMENT AGREEMENT

May 14, 1998

The Tennessee Department of Environment and Conservation has a public obligation to maintain a coordinated regulatory program for all regulated functions in the State and the standards by which programs are administered should be consistent. The Division of Solid Waste Management (DSWM) and the Division of Superfund (DSF) strive to achieve comparable levels of protection of human health, safety and the environment at sites.

This agreement is not intended to define the authority of either Division. Instead, it is to be utilized by the Divisions whenever oversight is needed at sites that could fall under the jurisdiction of either Division.

PURPOSE

The purpose of this agreement is to:

- 1) designate the appropriate Division to handle sites that are subject to the statutes of both Divisions, and to
- 2) promote consistency in site assessment and cleanup.

PRINCIPLES OF OPERATION

To the extent allowed by federal and state statutes, DSF and DSWM will strive to:

- 1) Achieve comparable levels of protection of human health and the environment when remedial and corrective actions are performed or overseen by the two Divisions.
- 2) Promote remedial and corrective actions at sites and facilities to levels which comply with CERCLA, RCRA, Part 1 and Part 2 of the Hazardous Waste Management Act (HWMA), the Solid Waste Management Act, the Clean Water Act, and the Clean Air Act.

The Divisions will pursue the following objectives:

- 1) Development of common soil standards or methodology for developing soil standards.
- 2) Development of consistent procedures for identification, investigation and remedial/corrective actions.
- 3) Apply consistent procedures to implement ground water classification rules and standards.

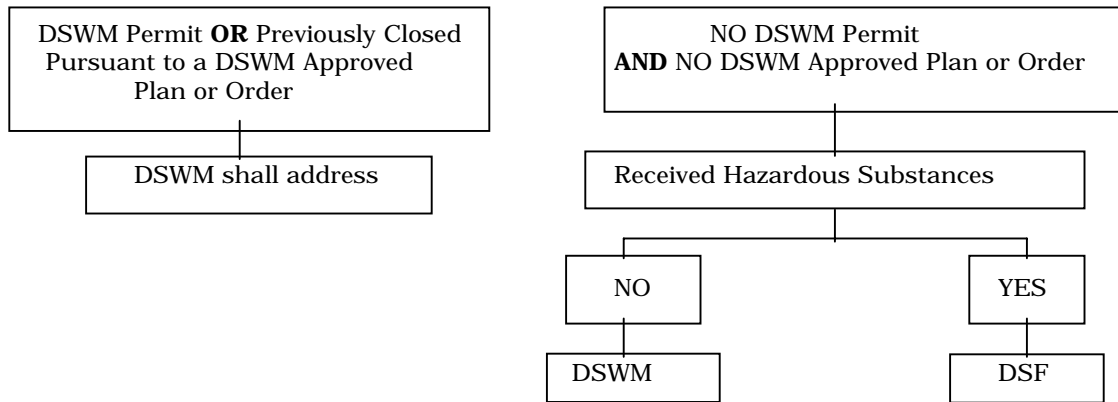
The Divisions will operate as follows:

- 1) The DSWM shall perform appropriate actions under the Solid Waste Management Act, Part 1 of the HWMA, and RCRA. The DSF shall perform appropriate actions under Part 2 of the HWMA and CERCLA.
- 2) Both Divisions shall strive to uniformly apply air, water, and soil standards.
- 3) Both Divisions shall maintain a current public record of sites or facilities being addressed. Files on said sites are public information and are accessible to other Division personnel, EPA, and the public by appointment during normal business hours.

DEFINITIONS

1. Facility means all contiguous land, and structures, other appurtenances and improvements on the land, used for treating, storing, or disposing of hazardous waste. A facility may consist of several treatment, storage, or disposal operational units.
 2. For the purposes of this agreement, inactive means there is not any active disposal taking place at the site, area or unit regardless of whether there is an ongoing business at the facility or site.
 3. Site means the areal extent of contamination and all areas in very close proximity to the contamination necessary for implementation of the remedial response.
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INACTIVE MUNICIPAL LANDFILL/DUMP PROCEDURE



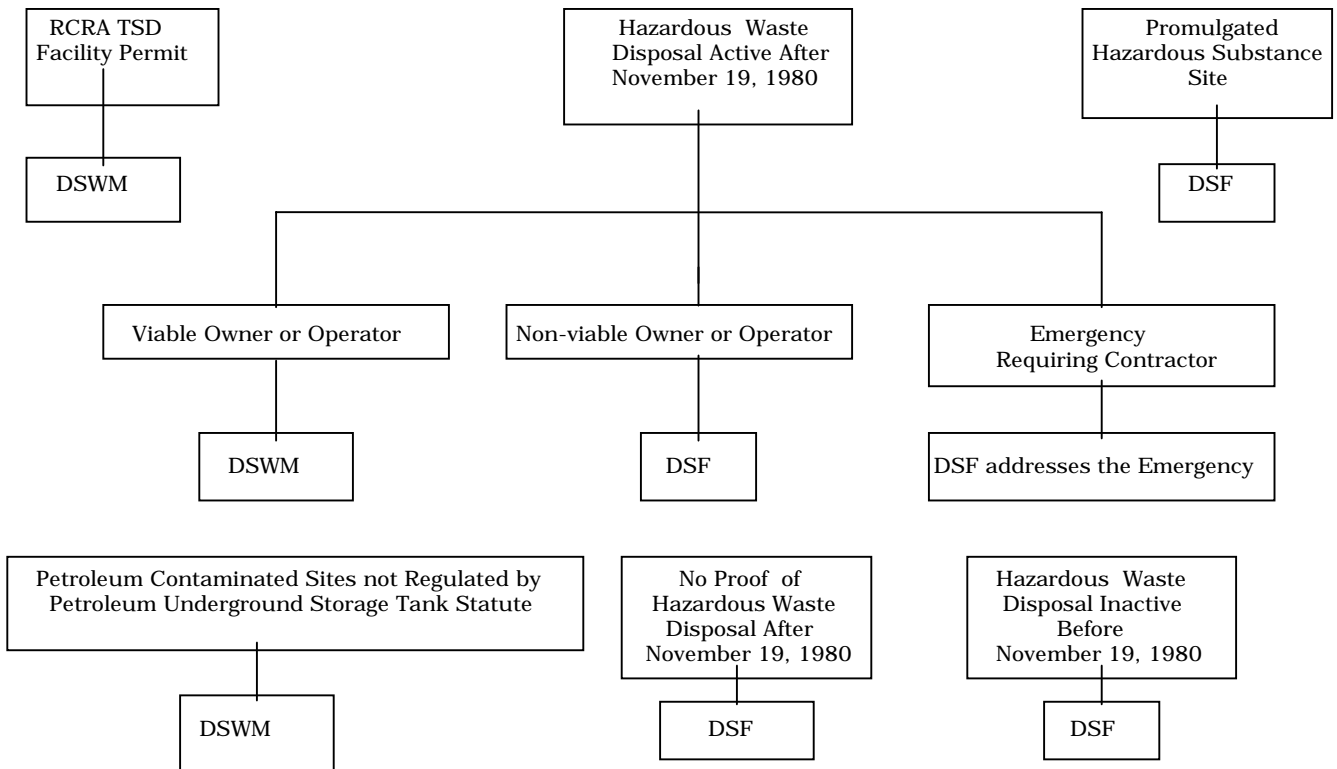
The DSWM shall address an inactive municipal landfill or dump if either:

- 1) the municipal landfill or dump had a DSWM permit or was closed pursuant to a DSWM approved plan or order, **or**
- 2) the municipal landfill or dump had no DSWM permit and the landfill or dump received no hazardous substances except those from households, farms, or demolition activities.

The DSF shall address the inactive municipal landfill or dump if:

- 1) the inactive municipal landfill or dump was not permitted by DSWM
- 2) the inactive municipal landfill or dump was not closed pursuant to a DSWM approved plan or order **and**
- 3) the landfill or dump received hazardous substances from sources other than households, farms, or demolition activities.

DISPOSAL SITE PROCEDURE



The Division of Solid Waste Management shall address the following sites:

- I. Where the hazardous waste disposal occurred at a RCRA permitted Treatment, Storage, and Disposal (TSD) Facility,
- II. Where the hazardous waste disposal occurred after November 19, 1980, and
- III. Petroleum contaminated sites not regulated under the Petroleum Underground Storage Tank statute.

The Division of Superfund shall address the following sites:

- I. Inactive hazardous substance sites where the hazardous waste disposal occurred and ceased before November 19, 1980.
- II. Inactive hazardous substance sites where there is no proof that hazardous waste disposal was taking place after November 19, 1980.
- III. Sites which are promulgated as inactive hazardous substance sites under T.C.A. Section 68-212-201 et seq.

SPECIAL CASES: (Where allowed by the statutes, if there is a conflict between the above generalizations and the special cases, the special cases shall take precedence)

- I. If either Division has issued an order or has initiated a regulatory action for investigation or remediation, said Division shall regulate the area through completion of the remediation process.
- II. If either Division is participating in a Memorandum of Agreement or Memorandum of Understanding with the Federal Government concerning a site or facility, this agreement between the Division of Solid Waste Management and the Division of Superfund shall not affect said participation responsibility.
- III. If USEPA has performed removal activities at a site under CERCLA, then the site shall be addressed by the Division of Superfund unless the removal activities were requested by the Division of Solid Waste Management.
- IV. Any site promulgated to the USEPA National Priorities List (NPL) or proposed for promulgation shall be addressed by the Division of Superfund.
- V. Drycleaner sites in the Drycleaner Environmental Response Program shall be addressed by the Division of Superfund.
- VI. RCRA Treatment Storage Disposal (TSD) Permitted Facilities or facilities where the hazardous waste disposal occurred after November 19, 1980 where:
 - A. the liable parties are bankrupt without financial assurance, or
 - B. no viable liable party under RCRA for corrective action can be foundthe facility may be transferred from DSWM to DSF to effectuate cleanup upon agreement between the Division Directors.
- VII. In the event of a multimedia investigation, the investigation team shall follow this agreement to assign the site.
- VIII. At a site where neither Division has begun a regulatory action for investigation or remediation and both Divisions have statutory authority to address the site, parties who are willing and able to perform an investigation and cleanup may petition their Division of choice to oversee the site investigation and cleanup.
- IX. The Commissioner or his designee may assign sites as deemed appropriate.

RCRA ENFORCEMENT AT DSF SITES

The DSWM may conduct a review process to identify RCRA violations which caused the contamination and may take enforcement action consistent with similar violations and circumstances. The DSF shall screen any sites that are proposed for the program which operated after November 19, 1980 to determine if potential RCRA violations have occurred. If so, this information will be turned over to the DSWM for possible enforcement action consistent with similar violations and circumstances. Further, if the willingness to cooperate of a liable party is considered in RCRA enforcement when oversighted by the DSWM, then parties oversighted by the DSF will be given the same consideration.

SITE SPECIFIC DETERMINATION

Nothing in this agreement prevents the Divisions from discussing specific sites and making site specific determination about which Division addresses the site. These agreements shall be made at the Division Director level. In the event a determination is not made at the Division Director level, then the Bureau of Environment Administrator will make the determination.

AGREEMENT REVIEW AND MODIFICATION

Technical and legal changes may require modification of these procedures. Therefore, the Division Directors will review this agreement as necessary. Changes to this agreement will be signed by both Division Directors and the Bureau of Environment Administrator.

AGREED to this date _____ and subject to change in writing upon assessment of the need.

Tom Tiesler, Director
Division of Solid Waste Management

Jim Haynes, Director
Division of Superfund

John Leonard
Bureau of Environment Administrator

SECTION 1.5

MEMORANDUM OR UNDERSTANDING BETWEEN THE USEPA, REGION 4, WATER MANAGEMENT DIVISION, UNDERGROUND STORAGE TANKS, AND THE STATE REMEDIATION PROGRAM

***The Memorandum of Understanding between USEPA ,Region 4, (Chemical Underground Storage Tanks) and the State Remediation Program is not available on diskette, but the printed manuscript is available upon request by calling the Division of Solid Waste Management-State Remediation Program at 615-532-0853.**

SECTION 2
DEFINITION OF TERMS

SECTION 2.0

DEFINITION OF TERMS

These definitions shall apply to the following words as they appear in Division correspondence:

1. The term "Area of Contamination" or ("AOC") shall mean any area of the facility under the control or ownership of the owner or operator where a release to the environment of solid waste(s), hazardous waste(s), hazardous substances or hazardous constituent(s) has occurred, is suspected to have occurred or may occur, regardless of the frequency or duration of the release.
2. The term "disposal" shall mean the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste, hazardous waste, hazardous substance or hazardous constituent into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any water, including groundwater.
3. The term "generation" shall mean any act or process which produces hazardous waste as identified or listed in Tennessee Hazardous Waste Management Regulations Rule 1200-11-.01(2)(a) and 40 CFR Part 261 or an act which first causes a hazardous waste to become subject to regulation.
4. The term "hazardous constituent" shall mean any constituent listed in Appendix VIII of Tennessee Hazardous Waste Management Regulations Rule 1200-1-11-.02(5)(a)1. and of 40 CFR Part 261.
5. The term "hazardous substance" shall mean (a) any substance designated pursuant to Section 311(b)(A) of the Federal Water Pollution Control Act, (b) any element, compound, mixture, solution, or substance designated pursuant to Section 102 of this Act, (c) any hazardous waste having the characteristics identified under or listed pursuant to Section 3001 of the solid Waste Disposal Act (but not including any waste the regulation of which under the Solid Waste Disposal Act has been suspended by Act of Congress), (d) any toxic pollutant listed under Section 307(a) of the Federal Water Pollution control Act, (e) any hazardous air pollutant listed under Section 112 of the Clean Air Act, and (f) any imminently hazardous chemical substance or mixture with respect to which the Administrator has taken action pursuant to Section 7 of the Toxic Substances Control Act. The term does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (a) through (f) or this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas). "Hazardous substance" shall include any mixtures of such hazardous substances with any other substances including petroleum products.
6. The term "hazardous wastes" shall mean a hazardous waste as defined in Tennessee Hazardous Waste Management Regulations Rule 1200-1-11-.02(1)(c) and 40 CFR Part 261.3.
7. The term ""you" or "Respondent" shall mean the addressee of an inquiry, the Addressee's officers, managers, employees shareholders, directors, consultants, contractors, trustees, successors, assigns and agents.

8. The term "solid waste" shall mean a solid waste as defined in Tennessee Code Annotated Section 68-211-103.
9. The term "release" means any spilling, leaking, pouring, emitting, emptying, discharging, injecting, pumping, escaping, leaching, dumping or disposing into the groundwater, surface water, air or soil. [See 50 Fed. Reg. at 28, 713(July 15, 1985).] This definition includes those facilities or sites which by virtue of a release or intentional act create a unit after the effective date of the regulations which cover their activities, regardless of whether they actively seek a permit. Spills which are immediately remediated are exempt and not subject to this definition [see 40 CFR, 264.1(g), Tennessee Rule 1200-1-11-.06(1)(b)(2) and 40 CFR, 265.1(c), Tennessee Rule 1200-1-11-.05(1)(b)(2); however, if cleanup activities do not begin promptly, spills are considered land disposal sites subject to permitting requirements. Further, extended responses which are not immediate in nature are also subject to permitting requirements. For purposes of this Section, spills which are not immediately remediated may be managed pursuant to the State Alternative Authorities. [see 48 Fed Reg. 2508-2512 (January 19, 1983), and OSWER Directive 9471.1986(01)]

SECTION 3.

APPLICABLE STATE REMEDIATION PROGRAM POLICY

- 3.0 PURPOSE OF THE SRP**
- 3.1 OPERATING PROCEDURES**
 - 3.1(a) COST RECOVERY ASSESSMENTS POLICY**
- 3.2 FACILITY ASSESSMENTS**
- 3.3 RESPONSE TO SPILL SITUATIONS**
- 3.4(a) CONTAMINATED MEDIA REMEDIATION LEVELS**
- 3.4(b) LIST OF REMEDIATION GUIDANCE LEVELS**
- 3.5 PETROLEUM CONTAMINATED SITES**
- 3.6 PETROLEUM ANALYTICAL METHODS**
- 3.7 DISPOSAL OF PETROLEUM CONTAMINATED MEDIA**
- 3.8 REPORTING REQUIREMENTS**
- 3.9 EVALUATION PROCESS FOR SITES ENTERING LONGTERM MONITORING, REMEDIATION OR GROUNDWATER CLASSIFICATION**

SECTION 3.0

PURPOSE OF THE SRS

SECTION 3.0

PURPOSE OF THE STATE REMEDIATION SECTION

The Division of Solid Waste Management reorganized the Hazardous Waste Program in November of 1994. Prior to the 1994 reorganization, the Division's RCRA Corrective Action Section and the Department's Office of General Counsel (OGC) recognized that the RCRA permitting process was not intended or equipped to remediate disposal sites that were not seeking a permit or did not have interim status. EPA's 1990 proposed Corrective Action Rule further supported the Division's position and encouraged the staff to begin implementing a corrective action program that did not follow the strict permitting regulations. Between 1990 and 1993 the Division pursued this course of action. This culminated with a presentation at the 1993 Solid Waste Conference by the Department's Office of General Counsel and Division's Corrective Action Section outlining the procedures the Division would follow, and presenting a draft of the Division's Corrective Action Order, which could be utilized in lieu of the RCRA Closure Plan and Post Closure Process. In November, 1994 the Division reorganized the Hazardous Waste central office program and divided the duties of the RCRA Corrective Action Section. This division resulted in there being a RCRA/HSWA Permitting and Land Facilities Section in addition to the State Remediation Program.

The State Remediation Program is responsible for the following types of sites:

1. Sites with one-time spills (or even multiple, long-term spills)
2. Sites with product storage releases
3. Petroleum contaminated sites (not involving registered USTs)
4. Sites where waste disposal occurred prior to July 26, 1982
5. Sites where there is a release from a registered chemical underground storage tank (Subtitle I).

While the State Remediation Program does not apply the strict procedural process of a permit, it does ensure that the final results are equivalent. This is done in a more efficient and timely manner than is possible utilizing the permitting regulations. Tennessee businesses have been very supportive of the program and are voluntarily disclosing potential problems to utilize this common sense approach. Sites that are permitted or are applying for a RCRA permit are handled by the Land Facilities Section with full compliance with the RCRA/HSWA permitting regulations and the associated procedural process. EPA headquarters guidance on corrective action strategies has consistently supported the theory of utilizing alternate State authorities in lieu of permitting requirements to obtain equivalent remediation results without the cumbersome permitting procedures that were not intended for these types of sites. The two most recent guidance documents addressing this issue are the May 1, 1996 EPA Proposed Rule 61-FR19432 (please see Appendix I) and the Herman/Laws letter dated September 24, 1996 (Please see Appendix 2). Both of these documents support the Divisions approach to site remediation.

While the SRP prefers to handle its projects in the voluntary mode, it does have the ability to initiate enforcement actions if the respondents are not willing to undertake the investigations and/or remediations deemed appropriate by the Division.

The Department has three primary remediation programs: The Division of Underground Storage Tanks (TDUST), the Division of Superfund (DSF) and the Division of Solid Waste Management/State Remediation Program (DSWM/SRP), each of which plays a unique role. TDUST has regulations which clearly delineate which sites they handle. To prevent confusion in choosing which Departmental Program is best suited to handle a site, the Department has initiated a Memorandum Of Agreement between the DSF and the DSWM. Basically, this proposed M.O.A. states that sites which handled hazardous substances and became inactive prior to November 19, 1980 are considered Superfund sites. All others that operated the disposal unit after November 19, 1980 are to be handled by the DSWM. However, it is standard practice to allow a facility to be handled by the Division of the responsible party's choice as long as the remediation and enforcement issues are addressed in an equivalent manner.

On August 8, 1997, the EPA Regional Administrator for Region IV signed a formal Memorandum of Agreement (please see Section 1.3) with the Department of Environment and Conservation establishing both the procedures to be utilized by the State Remediation Program and agreeing with the State's position that alternate State authorities can be utilized in lieu of the RCRA permitting process.

SECTION 3.1
OPERATING PROCEDURES

SECTION 3.1

OPERATING PROCEDURES FOR THE STATE REMEDIATION PROGRAM

The function of the State Remediation Program (SRP) is to address sites that are not being handled through the permitting process. These sites range from simple spill situations to complex remedial actions for various contaminants such as hazardous waste, hazardous substances, solid waste, petroleum, etc. In addition, the SRP provides technical guidance, support and coordination to the Division's environmental assistance centers in order to ensure continuity throughout the State in the implementation of the program.

Sites originating in the Field Office are screened to determine if a quick fix is appropriate or if it will be necessary for a more comprehensive investigation or remediation. If the initial assessment determines that further investigation and/or remediation is warranted, the site information is sent to the Director's attention with a brief memo detailing the work done to date. After review, the documents are then submitted to the SRP for issuance of the appropriate tracking mechanism (letters, Orders or Notices of Remediation) to the facility.

Once it is established that a site will be handled by the SRP, it must be screened to determine whether or not enforcement actions are appropriate. If so, the necessary information should be collected and submitted to the Division's Enforcement Section. This will take a separate track and not have any effect upon the remediation process.

A general guideline for the evaluation of sites entering the Division's Remediation Program is as follows:

1. Site is discovered (whether by the Division or voluntary disclosure)
2. Inspection of facility is conducted (either by field office or SRP).

- (1) Determination is made as to whether enforcement actions are appropriate.
- (2) Determination is made as to whether other areas of contamination (AOCs) are present at the facility.

- 3. Letter, Remediation Order or Notice of Remediation issued by the Division to address the contaminated area(s).

SECTION 3.2
FACILITY ASSESSMENTS

SECTION 3.2

FACILITY ASSESSMENTS

The following is the procedure for the State Remediation Program with regard to requiring facility assessments at sites under the program. Since this program handles many different types of remediation projects, it is necessary to categorize the project in order to determine what level of facility assessment would be appropriate.

As a standard operating procedure, the Section will define the facility limits and require that all projects submit, at a minimum, a certification letter from the owners and/or responsible parties that they have inspected the facility, interviewed workers and reviewed records to establish that, to the best of their knowledge, no other disposal areas exist at the facility. If any other areas are discovered, they will also be handled in accordance with the operating procedures, as outlined in Section 3.1.

In those instances where there are violations and it appears that an enforcement action is appropriate, a Facility Assessment will be required. This assessment can either be completed by the Section or by the facility with the Section's oversight. As a rule, the above two situations will cover most sites, however all sites will have to be evaluated and, if conditions warrant, a modified form of an assessment to a site wide assessment may be required. If there are potential areas of contamination (AOCs)) the following information should be obtained:

1. Name of AOC(s)
 - 1a. Description of each AOC
 - 1b. Location of AOC on a facility or other appropriate map
 - 1c. When AOC was operated or created
 - 1d. All wastes that have been managed or disposed at the AOC
 - 1e. All available information pertaining to any release of contaminants from the AOC.
 - 1f. All results from sampling and analysis of groundwater, soils, surface water or air that may have been affected by the AOC.
 - 1h. Any information or more detailed and complete information concerning the AOC that is not in the facility's possession, custody or control, and that the facility has reason to believe could be provided by another person(s), and identifying the person from whom such information may be obtained.

Where specific information has not been memorialized in a document, but is nonetheless responsive to any of the above requests, the facility must provide a written response. If information not known or not available to the facility as of the date of submission of a response to this Information Request should later become known or available, to the facility, the facility must supplement its response to the State. Moreover, should the facility find, at any time after the submission of the response, that any portion of the submitted information is false or misrepresents the truth, the facility must notify the State as soon as possible.

SECTION 3.3
RESPONSE TO SPILL SITUATIONS

SECTION 3.3
RESPONSE TO SPILL SITUATIONS

The following is intended to serve as guidance for Division personnel who respond to spill situations for the purpose of remediating the contaminated media associated with them. For the purpose of this guidance, a spill is defined as a situation where a facility or some form of storage container has inadvertently discharged into the environment and the responsible party has taken immediate action to minimize the potential of the discharged material to migrate. The Division must then determine what actions are necessary to remediate the contaminated soils after the initial response has contained and removed all free liquids and waste material from the spill site.

In these situations, the Field Office should inform the responsible party that they must remove all contaminated soil to levels at or below the Division's remediation standards (i.e., EPA Region IX PRGs). In order to ensure this goal has been met, confirmatory sampling should be performed to verify the material did not migrate to a deeper depth than what was excavated. These situations will have to be based on site conditions, type of material involved, etc. The Field Office should contact the State Remediation Program if they have any questions when these situations arise.

SECTION 3.4 (a)
CONTAMINATED MEDIA REMEDIATION LEVELS

SECTION 3.4a
CONTAMINATED MEDIA REMEDIATION LEVELS

The following is a Statement of Policy regarding the Division's remediation levels for media contaminated by hazardous constituents.

Since May of 2000, the Division has been utilizing the EPA Region 9 Preliminary Remediation Goals (PRGs) to establish no further action levels for remediation sites. When contaminants are encountered that are not in the listing, the SRP should be contacted and they will work with EPA's Toxicology Section to establish the appropriate level.

By using the PRGs, the Division establishes a level that is protective of both health and environment for the material left in place. Those levels are extremely conservative, and therefore, may be utilized without further risk assessments being performed. However, in some situations, these levels will not be obtainable and a risk assessment would be appropriate. The utilization of this criteria requires a determination that groundwater has not and cannot be adversely affected by the material left in place.

Based on the PRG Guidance, the following is a brief summary of the steps involved in determining the appropriate level that may be left in place at a site with no adverse health or environmental impact:

(The levels for the parameter of concern must be verified by the consultant with the State Remediation Program prior to the completion of the site remediation.)

The State Remediation Program does not utilize action levels to determine if additional assessment/remediation is warranted at contaminated sites. Once it is established that a disposal has occurred (either intentional or unintentional), the initial investigation must determine both horizontal and vertical extents of migration of the contaminants in all affected media (including groundwater) to either background or non-detect, not to an action level. This does not include spill situations that are addressed immediately. Once the extent of migration is established, a determination can be made as to what portion of the site warrants remediation. Remediation of soil is determined by two steps: One, the total level of the parameter of concern must be less than the level established in the Risk-Based Document for Ingestion; and secondly, the highest level left in place must not be capable of adversely affecting groundwater at the site.

For example, if the risk-based level for Lead in soil is 400 parts per million (this means that no adverse effects would occur if this material was ingested over a period of years) and the site verified that the highest level left in place is 100 ppm, the site has met the first criteria for remediation. However, the second step is for a leaching procedure to be run on this sample. If the leachate from this sample is below the MCL (Maximum Concentration Limit) for groundwater, then it proves that even under the worse case scenario (drinking the leachate or eating the soil) no adverse health effects would arise. However, if the leachate was above the MCL, we would require that either the soil be removed or treated to a lower contaminant level, or that a study be completed to show that the conditions at the site would not allow the groundwater to be adversely affected (attenuation, dilution, depth to groundwater, etc).

Of course, every site is different and there are other factors that must be considered, but as a general rule, this approach can be used to investigate and remediate a site.

SECTION 3.4 (b)

LIST OF REMEDIATION GUIDANCE LEVELS

The EPA Region 9 PRGs can be accessed at the following address:

www.epa.gov/region09/waste/sfund/prg/

SECTION 3.5
PETROLEUM CONTAMINATED SITES

SECTION 3.5
POLICY FOR PETROLEUM CONTAMINATED SITES

The following is a statement of policy for petroleum contaminated sites from sources other than underground storage tanks regulated under the authority of the Tennessee Petroleum Underground Storage Tank Act, T.C.A. 68-215-101 et seq. This policy statement addresses two main areas of concern: (1) regulatory placement of petroleum contaminated sites and (2) clean-up criteria for petroleum contaminated sites.

1. Procedures for Management of Petroleum Contaminated Sites

When a Field Office encounters a petroleum contaminated site that has the potential for deep soil and/or groundwater contamination, they should submit the information to the SRP. Sites with potential for deep soil and/or groundwater contamination are normally from long term or ongoing release sources. However, each site will have its own unique characteristics and in some cases further assessment may be needed in order for the Field Office to make a categorical determination. Sites submitted to the SRP will be put into the tracking system and issued one of the regulatory mechanisms mentioned below. Sites that do not require remediation orders or remediation letters are recent spills or releases that have not had time to migrate.

In order to promote consistency within our Division, the State Remediation Section has been assigned overall responsibility for petroleum contaminated sites not covered by the UST Act. The SRP has developed two categories for these petroleum contaminated sites. First, if any hazardous constituents are present (normally these will be from gasoline or waste oils), the site may be issued a Notice of Remediation or Remediation Order citing hazardous waste regulations. Second, if no hazardous constituents are present (normally this will be diesel fuels and hydraulic oils), the site will be issued a Remedial Action Notice citing solid waste regulations for the investigation and, if necessary, remediation of the site.

2. Clean-up Criteria for Petroleum Contaminated Sites

An amendment to T.C.A. 68-215-127 was signed into law May 3, 1996, (please see Section 1.4). This amendment was intended to provide a consistent and uniform approach to the establishment of clean-up standards for petroleum releases. Therefore, the Division's clean-up criteria will follow the promulgated levels in the Rules of the Division of Underground Storage Tank Program 1200-1-15-.06 (7)(e), parts 1 and 2, which are listed in Appendices 4 and 5. The pertinent information paraphrased from parts 1. and 2. and Appendices 4 and 5 is given below.

1. Ground water contaminated by petroleum must meet the levels as listed in Appendix 4 for drinking water supplies and non-drinking water supplies. It must be determined if the contaminated ground water met the definition of a "drinking water supply" before the contamination occurred. Site clean up levels will be based on the category of ground water.
2. The level of soil cleanup shall follow Appendix 5. Soil cleanup levels shall vary depending upon the permeability of the soil and whether the ground water below the site is a "drinking water supply" or "non-drinking water supply".

GROUNDWATER CLEANUP LEVELS FOR PETROLEUM CONTAMINATED SITES

PARAMETER	WATER CLASSIFICATION	CONCENTRATION LIMIT
BENZENE	DRINKING WATER	.005 PPM
	NON-DRINKING WATER	.070 PPM

TPH	DRINKING WATER	.100 PPM
	NON DRINKING WATER	1.00 PPM

**SOIL CLEAN-UP LEVELS FOR
PETROLEUM CONTAMINATED SITES**

PARAMETER	WATER CLASSIFICATION	SOIL PERMEABILITY		
BENZENE	DRINKING WATER	$>10^{-4}$ CM/SEC	10^{-4} TO 10^{-6} CM/SEC	$<10^{-6}$ CM/SEC
		5 PPM	25 PPM	50 PPM
	NON DRINKING WATER	25 PPM	50 PPM	100 PPM
TPH	DRINKING WATER	100 PPM	250 PPM	500 PPM
	NON DRINKING WATER	250 PPM	500 PPM	1000 PPM

It is the policy of the Division to achieve these remediation levels whenever possible. However, the Division recognizes that attaining these levels may not be practical in all situations. In these cases, the facility must attempt to remediate the site, then provide sufficient information to the Division that these remediation levels are unobtainable. The Division may then request a risk assessment. The risk assessment will be reviewed for the following subject matter:

- (1) Environmental impact of the contaminants to be left in place;
- (2) Technical feasibility of the contaminants to be removed or reduced; and
- (3) Economic feasibility of further reduction or removal of the contaminants.

Note: In order to ensure that the most current levels are being utilized in reference to petroleum standards, please refer to the following:

<http://www.state.tn.us/environment/ust/home.html>

SECTION 3.6
PETROLEUM ANALYTICAL METHODS

SECTION 3.6
PETROLEUM ANALYTICAL METHODS

As of May 1, 1998, the Division of Underground Storage Tanks will require the use of the EPH Method (extractable petroleum hydrocarbons) of analysis of samples for kerosene, diesel fuel, heating oil, motor oil, used oil or any other hydrocarbon which contains alkanes with 12 or more

carbons. This method replaces the DRO method and the 418.1 Method. An amendment to T.C.A. 68-215-127 that was signed into law May 3, 1996 was intended to provide a consistent and uniform approach to the investigation of petroleum contaminated sites. In order to comply with the amendment the DSWM has established investigative protocol consistent with the DUST. The following memorandum is intended to provide guidance regarding acceptable sample analytical methods for petroleum contaminated sites.

For investigations involving petroleum contaminated sites, the primary types of analyses performed are BTEX (Benzene, Toluene, Ethylbenzene and Xylene), GRO (Gasoline Range Organics) and EPH (Extractable Petroleum Hydrocarbons). The following is an explanation of each test method and when each method shall be applicable to a contaminated site. Please see Table I for Analytical Methods for Quantifying Petroleum Hydrocarbons, which will list acceptable analytical methods.

BTEX

This is a specific method for aromatic gasoline components, and one of the most important analytical methods for gasoline contaminated soils and groundwater since the aromatics are the most toxic contaminants. When analyzing for Total BTEX, the lab shall use Test Methods for Evaluating Solid Waste, commonly known as SW-846. The purge and trap procedures for the soil samples in Method 5030 shall be followed. The actual constituent analysis using gas chromatography with a photoionization detector shall follow Method 8020. The level of Total BTEX reported as the sum of Benzene, Toluene, Ortho-Xylene, Meta-Xylene, and Para-Xylene found in the sample as well as the concentration of the individual compounds must be reported. The practical quantitation limit for any individual constituent using this method is 0.002 ppm for low level soil samples. All results shall be reported in parts per million.

GRO (THE STATE OF TENN. METHOD)

This method provides gas chromatographic conditions for the detection of certain volatile petroleum fractions such as gasoline or other low boiling volatile hydrocarbons. Samples are analyzed utilizing purge-and-trap sample concentration, with quantification based on FID detector response to a gasoline component standard. At the State Lab, this test method is routinely run with samples to be analyzed for BTEX to obtain a more accurate determination of the contaminant concentrations. For example, at a site where the origin of the spill is unknown, a sample may have low BTEX concentrations, but have high GRO concentrations due to the fact that the petroleum contamination is from old or historical releases rather than from a recent release. Basically, unless the source of the contamination is known, analysis for BTEX and GRO should both be performed. A copy of the complete methodology of the State of Tennessee's GRO analysis can be found in Technical Guidance Document 003.

EPH (EXTRACTABLE PETROLEUM HYDROCARBONS)

This method is designed to measure the concentration of extractable petroleum hydrocarbons in in water and soil. This method is required for analysis of samples for kerosene, diesel fuel, heating oil, motor oil, used oil, or any other hydrocarbon which traditionally contains alkanes with 12 or more carbons. EPH analysis replaces the State of Tennessee DRO (diesel range organics) analysis that was formerly required by this Division. EPH is a method based on a solvent extraction, gas chromatography (GC) procedure. A copy of the complete methodology of the EPH Method can be found in Technical Guidance Document 004.

LEAD AND OTHER ADDITIVES

Using compounds such as tetramethyllead (TML) and tetraethyllead (TEL), lead was added to some gasolines to improve the octane number, thus achieving maximum power output in an engine. Other hazardous compounds, including ethylene dichloride (EDC) and Ethylene dibromide (EDB) were added as lead scavengers to prevent buildup of lead oxide deposits. Although leaded gasolines were phased out of most markets by 1989, if it is known or suspected that the contamination includes leaded gasoline, soil samples should be analyzed for EDC and EDB and possibly TEL. The State Laboratory can analyze for EDC and EDB under the same test method as for BTEX (Method 8260/5030), whereas analysis for TEL will require testing under Method 3580/8270A (modified)

Oxygenated compounds such as methanol, ethanol or methyl tertiarybutyl ether (MTBE) are sometimes added to gasoline as octane boosters to reduce carbon monoxide exhaust emissions. MTBE is volatile and very soluble in water and is useful through soil gas surveys as the first indication of a gasoline plume. Analysis for MTBE at the State Laboratory is done under Method 8260/5030

**ANALYTICAL METHODS FOR QUANTIFYING
PETROLEUM HYDROCARBONS**

ANALYSIS	METHOD (Soil and Groundwater)	WHEN APPROPRIATE
BTEX	8260 / 5030* 8020 / 5030	Gasoline contaminated sites Gasoline contaminated sites
GRO (Gasoline Range Organics)	State of TN's Method for GRO	Gasoline contaminated sites
EPH (Extractable Petroleum Hydrocarbons)	EPH Method by GC/FID	kerosene, diesel, heating oil, motor oil, used oil and heavier hydrocarbons
EDB, EDC	8260 / 5030* 504 (Drinking Water Standard)*	Gasoline (leaded) contaminated sites Gasoline (leaded) contaminated sites
TEL, TML	3580 / 8270 C (modified)	Gasoline (leaded) contaminated sites
MTBE	8260 / 5030*	Gasoline contaminated sites

* Designates test methods used by the State of Tennessee Environmental Laboratory

METHOD FOR DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS BY GC/FID

1. Scope and Application

1.1 Analytes

1.1.1 This method is designed to measure the concentration of Extractable Petroleum Hydrocarbons in water and soil. This corresponds to an alkane range of C₁₂-C₄₀.

1.1.2 The method is designed to measure mid to late-range petroleum products, such as diesel and spent motor oil, where contamination extends beyond diesel range organics. If, based on a review of the chromatogram, the presence of these product types is suspected, additional efforts may be performed including but not limited to, analysis of additional reference materials. These additional efforts are not contained within this method.

1.2 Quantitation Limits

1.2.1 Quantitation limits are based on 100 ug/ml of diesel/and or motor oil in the extract and are 0.10 mg/L for waters and 4.0 mg/kg for soils.

1.3 Dynamic Range

1.3.1 Dilutions should be performed as necessary to put the chromatographic envelope within the linear range of method. This is approximately equivalent to 100 ug/mL to 5000 ug/mL of oil in the final extract.

1.4 Experience

1.4.1 This method is based on a solvent extraction, Gas Chromatography (GC) procedure. This method should be used by, or under supervision of, analysts experienced in the use of solvent extractions and gas chromatographs. The analysts should be skilled in the interpretation of gas chromatograms and their use as a quantitative tool.

2. Method Summary

2.1 One liter of water or 25 grams of soil is spiked with a surrogate compound and extracted with methylene chloride. The extract is dried and concentrated to a volume of 1.0 mL. An (optional) internal standard is added to each extract, and 2 uL of extract is injected into a capillary column gas chromatograph equipped with a flame ionization detector (FID). Quantitation is performed by comparing the total chromatographic area to the response of oil/diesel.

2.2 This method is based in part on USEPA Methods 8000 and 8100, SW-846, "Test Methods for Evaluating Solid Waste", 3rd Edition (1), Method OA-2 (2) and work by the EPA Total Petroleum Hydrocarbons Methods Committee (3).

3. Definitions

3.1 Extracractable Petroleum Hydrocarbons (EPH): All chromatographic peaks eluting in the same retention time window as a representative diesel/oil standard mix.

3.2 Diesel/Oil Standard mix: An aliquot of commercial motor oil (10W30) obtained from a local outlet mixed 1 to 1 with an aliquot of diesel fuel(fuel oil #2) also obtained from a local outlet.

3.3 Surrogate Control Sample: A reagent water or method blank sample spiked with the surrogate compound used in the method. The surrogate recovery is used as a laboratory control. See 7.4.2.

3.4 Laboratory Control Sample: A reagent water or method blank sample spiked with diesel fuel (fuel oil #2) as a quality control check. The spike recovery is used as a laboratory control and must be greater than 50%. See 7.4.5.

3.5 Other terms are as defined in SW-846.

4. Interferences

4.1 Other organic compounds; including chlorinated hydrocarbons, phenols and phthalate esters are measureable. As defined in the method, the EPH results include these compounds.

4.2 Method interferences are reduced by washing all glassware with hot soapy water and then rinsing it with tap water, methanol, and methylene chloride. Reagent blanks must be analyzed with each batch or for every 20 samples to demonstrate that the samples are free from method interferences.

4.3 High purity reagents, such as Burdick and Jackson GC² methylene chloride or Baker capillary grade methylene chloride, must be used to minimize interference problems.

4.4 Contamination by carryover can occur whenever high-level and low-level samples are sequentially analyzed. Whenever an unusually concentrated sample is encountered, it should be followed by an analysis of a solvent blank to check for cross-contamination.

5. Safety Issues

5.1 The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. However, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. The laboratory is responsible for maintaining a current awareness file of Occupational Safety and Health Administration (OSHA) regulations regarding the safe handling of the chemicals specified in this method. A reference file of Material Safety Data Sheets (MSDS) should also be made available to all personnel involved in the chemical analysis. Additional references to laboratory safety should be available and should be identified for use by the analyst.

6. Apparatus

6.1 Glassware

6.1.1 All specifications are suggested only.

6.1.2 4 oz. amber glass wide mouth jars.

6.1.3 Separatory funnel - 2000 mL with Teflon stopcock.

6.1.4 Concentrator tube. Kuderna-Danish - 10 mL graduated (Kontes K-570050-1025 or equivalent). Calibration must be checked at the volumes employed in the test. Ground glass stopper is used to prevent evaporation of extracts.

6.1.5 Evaporative flask, Kuderna-Danish - 500 mL (Kontes K-570001-0500 or equivalent). Attach to concentrator tube with springs.

6.1.6 Snyder column, Kuderna-Danish - three ball macro (Kontes K-503000-0121 or equivalent). Rotary evaporation set-up may also be used alternatively.

6.1.7 Vials - Amber glass, 10 to 15 mL capacity, with Teflon-lined screwcap. One mL glass vials with teflon-lined cap.

6.1.8 Reaction flask - Pyrex glass, 15 to 25 mL round bottom flask with standard tapered joint, fitted with a water cooled condenser and U-shaped drying tube containing granular calcium chloride.

6.1.9 Disposable pipets: Pasteur

6.2 Boiling chips - Approximately 10/40 mesh. Heat to 400°C for 30 minutes or Soxhlet extract with methylene chloride.

6.3 Microsyringes: 1 uL, 5 uL, 10 uL, 25 uL and 100 uL

6.4 Water bath - Heated with concentric ring cover, capable of temperature control (+/-2°C). The bath should be used in a hood.

6.5 An analytical balance capable of accurately weighing 0.0001g should be used for standards. A top-loading balance capable of weighing to the nearest 0.1 g should be used for sample analysis.

6.6 Gas Chromatography

6.6.1 Gas Chromatograph: Analytical system complete with gas and all required accessories, including a flame ionization detector, column supplies, gases and syringes. A data system capable of determining peak areas using a forced baseline and baseline projection is required. A data system capable of storing and reintegrating chromatographic data is recommended.

6.6.2 Columns

6.6.2.1 Column 1: 12M x 0.2mm ID x 0.33 micron film thickness DB-1, or equivalent.

6.6.2.2 Other columns may be used - capillary columns are required. See 9.2.2 for GC criteria.

6.7 Sonication

6.7.1 Ultrasonic cell disrupter: A horn-type sonicator equipped with a titanium tip should be used. A Heat Systems Ultrasonics, Inc. Model W-385 (475 watt) sonicator or equivalent (power wattage must be a minimum of 375 with pulsing capability and No. 200 1/2" Tapped Disrupter Horn) plus No. 207 3/4" Tapped Disrupter Horn, and No. 419 1/8" Standard tapered Microtip probe.

6.7.2 A Sonabox is recommended with the above disrupter for decreasing sound (Heat Systems-Ultrasonics, Inc., Model 432 13 or equivalent).

6.8 Soxhlet extraction apparatus is described in Method 3540.

6.9 Nitrogen evaporator with high purity nitrogen gas source.

7. Reagents and Standards

7.1 Reagent water: Carbon filtered deionized water

7.2 Methylene chloride, hexane, acetone - pesticide grade or equivalent.

7.3 Sodium sulfate - (ACS) granular, anhydrous. Purify by heating at 400°C for 4 hours in a shallow tray.

7.4 Stock standard solution - Prepare the following stock standards. Unless noted, all are prepared in the methylene chloride listed in 7.2. Standard preparation should follow guidelines in Method 8000.

7.4.1 Optional Stock Internal Standard: 1000 ug/mL 5 α -androstane.

7.4.2 Recommended Surrogate Standard: 2000 ug/mL ortho-terphenyl (OTP). A working solution is made at 20 ug/mL in acetone (a water soluble solvent). Other appropriate surrogates may be used.

7.4.3 Diesel/Oil Standard: 1 to 1 Commercial diesel/motor oil mix at approximately 100 ng/uL up to 5,000 ng/uL.

7.4.4 Stock Laboratory Control Sample - 5000 ug/mL diesel. A working solution is made at 1000 ug/ml in methylene chloride.

8. Sample collection, Preservation, Containers, and Holding Times

8.1 Water samples are collected in an one liter glass container, acid preserved and soils in a glass jar. The samples are stored at 4°C from the time of collection until extraction. Extraction must be performed on waters within seven days and soils within 14 days. All analysis must take place within 40 days.

9. Procedure

9.1 Sample preparation

9.1.1 Waters are extracted according to SW-846 Method 3510 (Separatory Funnel Liquid-Liquid Extraction) or Method 3520 (Continuous Liquid-Liquid Extraction). Soil samples are extracted using Method 3550 (Sonication). Method 3540 (Soxhlet Extraction) may also be used.

9.1.2 Water extraction - Separatory Funnel

9.1.2.1 Measure a 1-L portion of the sample and transfer to the 2-L separatory funnel. If the sample is in a 1 liter or smaller bottle, mark the water meniscus on the side of the sample bottle for later determination of the sample volume. If the sample is in a larger bottle, use a 1 liter graduated cylinder. Pour the sample into a 2 liter separatory funnel. For blanks and quality control standards, pour 1 liter of carbon filtered water into the separatory funnel.

9.1.2.2 Check and note the initial pH.

9.1.2.3 Add 1 mL of ortho-terphenyl surrogate standard at 20 ug/mL.

9.1.2.4 For every batch or 20 samples extracted, prepare duplicate laboratory control samples by adding 1 mL of 1000 ug/mL diesel (laboratory control standard) to each of two blank matrices. Daily or for every 20 samples, prepare a blank/surrogate control standard using 1 L of carbon filtered water.

9.1.2.5 For samples that were mixed before extraction, add 60 mL CH₂Cl₂ to the sample bottle to rinse the inner walls. Do **NOT** cap and shake the bottle, rinse the glass only; transfer the solvent to the separatory funnel. Extract the sample by shaking it for two minutes with frequent ventilation.

9.1.2.6 Allow the layers to separate. If there is an emulsion, break it. If the emulsion cannot be broken (recovery of <80% of the methylene chloride, corrected for water solubility of methylene chloride), transfer the sample, solvent, and emulsion into the extraction chamber of a continuous extractor and proceed as described in 9.1.3.

9.1.2.7 Drain the bottom layer (CH₂Cl₂) into a 250 mL beaker.

9.1.2.8 Repeat the extraction twice more using a 60 mL aliquot of CH_2Cl_2 each time. Collect the solvent in the same beaker described in 9.1.2.7. Record the volume recovered.

9.1.2.9 Put a plug of glass wool in a funnel and fill about 2/3 full with Na_2SO_4 . Rinse the funnel and Na_2SO_4 with 30-40 mL of CH_2Cl_2 , discard. Pour the extract through the Na_2SO_4 into a 500 mL Kuderna-Danish (K-D) evaporative concentrator. Rinse the beaker then the Na_2SO_4 with small amounts of CH_2Cl_2 . Add these rinses to the K-D.

9.1.2.10 Add a boiling chip to the K-D and attach a 3 ball Snyder to the top. Pre-wet the column by adding about 1 mL of CH_2Cl_2 to the top. NOTE: The concentration step is critical; losses can occur if care is not taken.

9.1.2.11 Place the K-D in a heated water bath set at 95°C so that the receiver tube is immersed in hot water and the entire lower rounded surface is bathed in steam. At a proper rate of distillation, the balls of the column will actively chatter, but the chambers will not flood. When the apparent volume reaches 5-10 mL, remove the K-D from the bath and allow it to cool completely.

9.1.2.12 If the extract is highly colored or a precipitate forms during concentration, the final volume should be higher (5-10 mL).

9.1.2.13 After the K-D has cooled, rinse the Snyder column and middle flask with a small amount of CH_2Cl_2 . Transfer the extract to a calibrated 15 mL centrifuge tube, rinsing with a small amount of CH_2Cl_2 . Be sure to rinse all of the ground glass joints well, as compounds collect on the ground glass.

9.1.2.14 Carefully concentrate the extract to 1.0 mL under a gentle stream of nitrogen using the N-evap apparatus. If the extract is highly colored, forms a precipitate, or stops evaporating, the final volume should be higher (5-10 mL). Transfer to a labeled 4 mL (or 12 mL) vial with Teflon lined cap, mark the meniscus.

9.1.2.15 Record the prep information for the extraction and concentration steps. The sample extract is ready for analysis (See Section 9.2 through 9.6).

9.1.3 Water extraction - Continuous liquid liquid extraction

9.1.3.1 Mount the continuous extractor on appropriate racks.

9.1.3.2 Put 250 mL CH_2Cl_2 in a round bottom flask and add a few boiling chips. Add 300 mL of CH_2Cl_2 to the extractor flask.

9.1.3.3 When pouring water into the extractor, minimize the disturbance of the solvent layer and avoid getting water into either sidearm by pouring the water down the back of the extractor.

9.1.3.4 Check and note the pH.

9.1.3.5 For samples in 1 liter of smaller bottles, mark the meniscus on the side of the sample bottle and pour approximately 1 liter of the sample into the extractor flask. Measure the exact volume by adding tap water to the bottle to the marked level and measuring the volume with a graduated cylinder. For samples in bottles larger than 1 liter, measure 1 liter of the sample in a graduated cylinder. Record the volume.

9.1.3.6 Add enough carbon filtered water to the extractor flask to allow the solvent in the removeable sidearm to just begin to drip into the round bottom flask. Record the total volume carbon filtered water that was added on the prep sheet.

9.1.3.7 Remove the condenser from the rack and wipe the lower joint and lip with a tissue soaked with solvent. Place the condenser on the top of the extractor. Turn on the cool water supply and check the flow indicators.

9.1.3.8 Turn on the heating mantle. Record the starting time on the prep sheet. Check after 15 minutes to be sure that the solvent in the round bottom flask is boiling, that solvent is dripping from the lip on the condenser, and that the volume of the solvent in the round bottom flask is still about 240 mL.

9.1.3.9 Check all extractor joints for leaks with a Kimwipe. Allow the extraction to proceed for 18-24 hours.

9.1.3.10 Turn off the heating mantle and allow the apparatus to cool (30-60 minutes) with water flowing through the condenser.

9.1.3.11 The solvent contained in the round bottom flask is the extract. Transfer the extract to a 400 mL beaker, rinsing with a small amount of CH_2Cl_2 . If the volume of solvent is less than about 250 mL, record the solvent volume.

9.1.3.12 Go to 9.1.2.9 and proceed with the prep.

9.1.4 Soil preparation - Sonication

9.1.4.1 Remove large rocks or other foreign materials and mix the sample well. Chop any vegetation into small pieces.

9.1.4.2 Weigh 25 g of the original sample into a 250 mL centrifuge bottle. Add 25 g of dried Na_2SO_4 and stir the mixture well with a steel spatula. The sample should have a grainy texture - if it forms a large clump, add more Na_2SO_4 and note it on the prep sheet.

9.1.4.3 Add 100 mL of CH_2Cl_2 to all samples.

9.1.4.4 Add 1 mL of 20 ug/mL ortho-terphenyl to all samples and standards. Mix the samples immediately.

9.1.4.5 Add 1 mL of 1000 ug/mL diesel (laboratory control standard) to the duplicate laboratory control standards. These standards should contain 25 g of Ottawa Sand. In addition, prepare a reagent blank/surrogate control standard containing 1 mL of 20 ug/mL ortho-terphenyl.

9.1.4.6 Sonicate the samples for 1.5 minutes at an output setting of 10 with the 3/4 inch sonicator horn 1/2 inch below the surface of the solvent. The sonicator should be in the 1 second pulse mode, with the duty cycle set at 50%. Centrifuge the samples for 3-5 minutes at 35 RPM.

9.1.4.7 Decant the solvent layer into a rinsed 400 mL beaker.

9.1.4.8 Repeat the extraction twice more using 100 mL aliquots of CH_2Cl_2 each time. Collect these extracts in the same beaker described in 9.1.4.9.

9.1.4.9 Record the total volume of the solvent that is recovered.

9.1.4.10 Go to 9.1.2.9 and proceed with the prep.

9.1.5 Dilution Technique

9.1.5.1 This is used for product or waste samples which are soluble in methylene chloride.

9.1.5.2 Weigh 1 g of sample into a 10 mL volumetric flask. Dilute to 10 mL with CH₂Cl₂. Store in a 12 mL vial.

9.2 Gas Chromatography

9.2.1 Conditions (Recommended): Set helium column flow to 1 mL/min. Set column temperature to 35°C for 14 minutes, then 10°C/min to 210°C, then raise to 320°C at 40/min and hold 10 min. The FID temperature should be set at 300°C and the injector to 250°C. These conditions may vary depending upon equipment.

9.2.2 Performance Criteria: GC run conditions and columns must be chosen to meet the following criteria:

9.2.2.1 Resolution from the solvent front and o-terphenyl of C₂₂.

9.2.2.2 The column must be capable of separating typical oil components from the surrogate and internal standards.

9.3 Calibration

9.3.1 Calibrate the GC with an initial five point calibration using the commercial diesel/oil standard (7.4.4). Tabulate the area response of the diesel/oil standard. The ratio of the response to the amount injected, defined as the response factor (RF), can be calculated for the standard at each concentration. If the percent relative standard deviation (%RSD) is less than 25% over the working range, linearity through the origin can be assumed, and the continuing calibration response factor can be used in place of a calibration curve.

$$\text{Response Factor} = \frac{\text{Total area of commercial diesel/oil} \times \text{I.S. amount (mg/mL)}}{\text{Total diesel/oil standard amount (mg/mL)} \times \text{I.S. area}}$$

Note: I.S. = Internal Standard (optional)

Alternately, external standard calibration may be used (See SW-846 Method 8000).

9.3.2 The working response factor or calibration curve must be verified on each working day by the injection of a continuing calibration standard (CCS), mid-point. If the response for this standard varies from the predicted response by more than +/-25%, a new calibration curve must be prepared.

$$\text{Percent Difference} = \frac{R_1 - R_2}{R_{\text{avg}}} \times 100$$

where: R_1 = Average RF from the calibration curve

R_2 = Response Factor from CCS

$$R_{\text{avg}} = (R_1 + R_2)/2$$

9.4 Retention Time Window Definition

9.4.1 Before establishing windows, be certain that the GC system is within optimum operating conditions. Make three injections of the method standard throughout the course of a 72 hour period. Serial injection over less than a 72 hour period result in retention time windows that are too tight.

9.4.2 Calculate the standard deviation of the three absolute retention times for the surrogate and/or internal standard.

9.4.2.1 The retention time window for individual peaks is defined as plus or minus three times the standard deviation of the absolute retention time for each component.

9.4.2.2 In those cases where the standard deviation for a particular analyte is zero, the laboratory should use +/-0.05 min as a retention time window.

9.4.3 The laboratory must calculate retention time windows for each standard on each GC column and whenever a new GC column is installed. The data must be retained by the laboratory.

9.5 Gas Chromatograph Analysis

9.5.1 Samples are analyzed by GC/FID. Suggested injection volumes are 2 uL using the conditions established in 9.2.

9.5.2 For internal standard calibration, 5- α androstane internal standard is spiked into each sample and standard at a concentration of 20 ug/mL of sample extract. 20 uL of 5- α Androstane stock at 1000 ug/mL may be spiked into the 1 mL final volume or a corresponding amount may be added to an aliquot of the final extract.

9.5.3 If initial calibration (9.3.1) has been performed, verify the calibration by analysis of a mid-point CCS (9.3.2). The midpoint standard must also be run once every ten runs and at the end of each sequence.

9.5.4 Calculate the percent difference of the response factor from the mean response factor as in 9.3.2. If the response factors have a percent difference >+/-25%, the instrument must be recalibrated (9.3.1).

9.5.5 A methylene chloride blank must be run in every sequence to determine the area generated on normal baseline bleed under the conditions prevailing in the 24 hour period. This area is generated by projecting a horizontal baseline between the retention times observed for C₁₂ and C₄₀. This area is subtracted from the EPH area generated in the same manner for the samples.

Methylene chloride blanks should also be run after samples suspected of being highly concentrated to prevent carryover.

9.5.6 If the product concentration exceeds the linear range of the method in the final extract, the extract must be diluted and reanalyzed.

9.6 Calculations

9.6.1 Internal Standard Calibration: The concentration of Extractable Petroleum Hydrocarbons in the sample is determined by calculating the absolute weight of analyte chromatographic peaks eluting in the defined retention time window of oil, using the calibration curve or the response factor determined in 9.3.2. Refer to 9.4. The concentration of Extractable Petroleum Hydrocarbons is calculated as follows:

Aqueous/Soil samples:

$$C_s = \frac{A_x}{A_s} \times \frac{C_{is}}{RF} \times \frac{V_t}{V_s} \times D$$

Where:

C_s = Concentration of Extractable Petroleum Hydrocarbons (mg/L or mg/kg).

A_x = Response for the Extractable Petroleum Hydrocarbons in the sample, units in area.

RF = Response Factor from continuing calibration (See 9.3.1).

A_s = Response for the internal standard, units same as for A_x.

C_{is} = Concentration of Internal Standard (mg/mL).

V_i = Volume of Final extract (mL).

D = Dilution factor

V_s = Volume of sample extracted in L or kg.

9.6.2 Alternately, external standard calibration may be used (See SW-846 Method 8000).

10. Quality Control

10.1 The laboratory must establish the ability to generate acceptable accuracy and precision. This should include the analysis of QC check samples plus the calculation of average recovery as outlined in Method 8000, Section 8.0.

10.2 The laboratory must, on an ongoing basis, demonstrate through the analysis of quality control check standards that the operation of the measurement system is in control.

10.3 After successful calibration (Section 9.3), analyze a Surrogate Control Sample. This standard is also the reagent blank sample and is analyzed with every analytical batch or sequence. The surrogate recovery should be within established limits (Table 1) and the sample should not have Extractable Petroleum Hydrocarbons above the practical quantitation limit.

10.4 Every batch or 20 samples, duplicate Laboratory Control samples must be analyzed. The accuracy and precision of the duplicate standards must be within established limits (Table 1).

10.5 Each laboratory should generate control limits based on the average recovery ± 3 standard deviations.

10.6 If any of the criteria in 10.3 and 10.4 are not met, the problem must be corrected before samples are analyzed.

10.7 Calculate the surrogate standard recovery in each sample. If recoveries are outside established limits, verify calculations, dilutions and standard solutions. Verify instrument performance.

10.7.1 High recoveries may be due to a coeluting matrix interference; examine the sample chromatogram.

10.7.2 Low recoveries may be due to the sample matrix.

10.8 Field blanks, duplicates and matrix spikes are recommended for specific sampling programs. Matrix spikes should use the spike levels specified for laboratory control samples.

12. References

1. USEPA "SW-846 Test Methods for Evaluating Solid Waste", 3rd Edition; Methods 8000, 8100, 3510, 3520, 3540, and 3550.

2. "Method OA-2: Extractable Petroleum in Products: Revision January 10, 1990; University Hygienic Laboratory, Iowa City, Iowa.

3. "Method for Determination of Extractable Petroleum Hydrocarbons (EPH) in Soil and Water" - Draft - February 28, 1990; prepared for Total Petroleum Hydrocarbons Method Committee by Midwest Research Institute.

4. Zillis, K., M. McDevitt, and J. Parr; "A Reliable Technique for Measuring Petroleum Hydrocarbons in the Environment," presented at the conference on Petroleum Hydrocarbons and Organic Chemicals in Groundwater, NWWA, Houston, Texas, November 1988.

5. "Leaking Underground Fuel Tank (LUFT) Field Manual," State Water Resources Control Board, State of California, Sacramento, CA, May, 1988.

6. Fitzgerald, John "Onsite Analytical Screening of Gasoline Contaminated Media Using a Jar Headspace Procedure" in Petroleum Contaminated Soils, Vol. 2, 1989.

7. Senn, R.B., and M.S. Johnson, "Interpretation of Gas Chromatographic Data in Subsurface Hydrocarbon Investigations," Ground Water Monitoring Review, 1987.

8. Hughes, B.M., D.E. McKenzie, C.K. Trang, L.S.R. Minor, "Examples of the Use of an Advanced Mass Spectrometric Data Processing Environment for the Determination of Sources of Wastes" presented at 5th Annual Waste Testing and Quality Assurance Symposium, July 24-28, 1989.

9. ASTM "Standard Methods for Comparison of Waterborne Petroleum Oils by Gas Chromatography," 3328-78.

TABLE I

ACCEPTANCE CRITERIA FOR LCS AND SCS

Laboratory Control Sample	%Rec	Relative %Difference
Extractable Petroleum Hydrocarbons	50-100	20
Surrogate Control Standard		
ortho-Terphenyl	50-150	

METHOD FOR DETERMINATION OF GASOLINE RANGE ORGANICS

1. Scope and Application

1.1 This method is used to determine the concentration of gasoline range organics in water and soil. This corresponds to an alkane range of $C_6 - C_{10}$ and a boiling point range between approximately 60°C and 170°C. Gasoline or other specific petroleum products may be identified by the use of pattern recognition.

1.2 The practical quantitation limit (PQL) of this method for gasoline range organics is approximately 5 mg/kg for soils and 0.1 mg/L for ground water.

1.3 This method is based on a purge-and-trap, Gas Chromatography (GC) procedure. This method should be used by, or under supervision of, analysts experienced in the use of purge-and-trap systems and gas chromatographs. The analyst should be skilled in the interpretation of gas chromatograms and their use as a quantitative tool.

1.4 With the optional PID detector, this method can be extended for the specific determination of volatile aromatics (BTEX) as specified in SW-846 Method 8020.

1. Summary of Method

2.1 This method provides gas chromatographic conditions for the detection of certain volatile petroleum fractions such as gasoline. Samples are analyzed utilizing purge-and-trap sample concentration. The gas chromatograph is temperature programmed to facilitate separation of organic compounds. Detection is achieved by a flame ionization detector (FID) or FID with photoionization detector (PID) in series (PID first in the series). Quantification is based on FID detector response to a gasoline component standard.

2.2 This method is suitable for the analysis of waters, soils or wastes. Water or low level soil samples can be analyzed directly for gasoline range organics by purge-and-trap extraction and gas chromatography. High level soil or waste samples are dispersed in methanol to dissolve the volatile organic constituents. A portion of the methanolic solution is analyzed by purge-and-trap GC following the normal water method.

3. Definitions

3.1 Gasoline Range Organics (GRO): All chromatographic peaks eluting between 2-methyl pentane and 1,2,4-trimethylbenzene. Quantification is based on a direct comparison of the area within this range to the total area of the 10 components in the gasoline component standard.

3.2 Gasoline Component Standard: A ten component blend of typical gasoline compounds (Table 3). This standard serves as a quantification standard and a retention time window-defining mix for gasoline range organics. It may also be used as the PID calibration standard for the optional determination of BTEX by Method 8020.

3.3 Gasoline Control Standard: A commercial gasoline used by the laboratory as a quality control check. See 7.2.

3.4 Surrogate Control Sample: A reagent water or method blank sample spiked with the surrogate compounds used in the method. The surrogate recovery is used to evaluate method control. See 7.8.

3.5 Laboratory Control Sample: A reagent water or method blank sample spiked with the gasoline control standard. The spike recovery is used to evaluate method control and must be greater than 50%.

3.6 Other terms are as defined in SW-846.

4. Interferences

4.1 High levels of heavier petroleum products, such as diesel fuel, may contain some volatile components producing a response within the retention time range for gasoline. Other organic compounds, including chlorinated solvents, ketones and ethers are measurable. As defined in the method, the GRO results include these compounds.

4.2 Samples can become contaminated by diffusion of volatile organics through the sample container septum during shipment and storage. A trip blank prepared from reagent water and carried through sampling and subsequent storage and handling can serve as a check on such contamination.

4.3 Contamination by carryover can occur whenever high-level and low-level samples are sequentially analyzed. To reduce carryover, the sample syringe and/or purging device must be rinsed between samples with reagent water or solvent. Whenever an unusually concentrated sample is encountered, it should be followed by an analysis of a solvent blank of reagent water to check for cross contamination. For volatile samples containing high concentrations of water-soluble materials, suspended solids, high boiling compounds or organohalides, it may be necessary to wash the syringe or purging device with a detergent solution, rinse with distilled water, and then dry in an 105°C oven between analyses. The trap and other parts of the system are also subject to contamination; therefore, frequent bake-out and purging of the entire system may be required. A screening step is recommended to protect analytical instrumentation.

5. Safety Issues

5.1 The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; each chemical compound should be treated as a potential health hazard. Exposure to these chemicals must be reduced to the lowest possible level by whatever means available. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of material safety data sheets should also be made available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available and have been identified for the information of the analyst.

6. Apparatus and Materials

6.1 Gas Chromatograph: Analytical system complete with gas chromatograph suitable for purge-and-trap sample introduction and all required accessories, including detectors, columns, supplies, recorder, gases and syringes. A data system capable of determining peak areas is required.

6.1.2 Columns

6.1.2.1 Column 1: 105 m x 0.53 mm I.D. Restek RTX 502.2 0.3 micron film thickness, or equivalent.

6.1.2.2 Other columns such as 30 m x 0.53 mm DB-5 may be used - capillary columns are recommended to achieve necessary resolution. At a minimum, the column should resolve 2-methylpentane from the methanol solvent front in a 25 mg/kg LCS standard and should resolve ethylbenzene from m/p-xylenes. Some columns may require subambient cooling to achieve these guidelines.

6.1.3 Detector: Flame ionization detector (FID), or FID in series with a photoionization detector (PID).

6.2 Syringes: 5 mL Luerlock glass hypodermic and a 5 mL gas-tight syringe with shutoff valve.

6.2.1 For purging large sample volumes for low detection limit analysis of aqueous sample for petroleum products, 25 or 50 mL syringes may be used. Subsequently, substitute the appropriate volume in the method wherever 5 mL is stated.

6.3 Volumetric flask: 10 mL, 50 mL, 100 mL, 500 mL and 1000 mL with a ground-glass stopper.

6.4 Microsyringes: 1 uL, 5 uL, 10 uL, 25 uL, 100 uL, 250 uL, 500 uL and 1000 uL.

6.5 Syringe valve: Two-way, with luer ends (three each), if applicable to the purging device.

6.6 Balance: Analytical, capable of accurately weighing to the nearest 0.0001 g, and a top-loading balance capable of weighing to the nearest 0.1 g.

6.7 Glass scintillation vials: 20 mL, with screw-caps/crimp caps and Teflon liners or glass culture tubes with a screw-cap and Teflon liner, or equivalent.

6.8 Spatula: Stainless steel.

6.9 Disposable pipets: Pasteur.

6.10 Purge-and-trap device: The purge-and-trap device consists of three separate pieces of equipment: the sample purger, the trap and the desorber. Several complete devices are commercially available.

6.10.1 The recommended purging chamber is designed to accept 6 mL samples with a water column at least 3 cm deep. The gaseous headspace between the water column and the trap must have a total volume of less than 15 mL. The purge gas must pass through the water column as finely divided bubbles with a diameter of less than 3 mm at the origin. The purge gas must be introduced no more than 5 mm from the base of the water column. The sample purger, illustrated in Figure 1 meets these design criteria. Alternate sample purge devices may be used, provided equivalent performance is demonstrated.

6.10.2 The trap must be at least 25 cm long and have an inside diameter of at least 0.105". Starting from the inlet, the trap must be packed with the following adsorbents: 1/2 of 2,6-diphenylene oxide polymer, 1/3 of silica gel and 1/2 of coconut charcoal. It is recommended that 1.0 cm of methyl silicone-coated packing be inserted at the inlet to extend the life of the trap (see Figures 2 and 3). Since only compounds boiling above 35°C are to be analyzed by this method, both the silica gel and charcoal can be eliminated and the polymer increased to fill the entire trap. Prior to initial use, the trap should be conditioned overnight at 180°C by backflushing with an inert gas flow of at least 20 mL/min. Vent the trap effluent to the hood, not to the analytical column. Prior to daily use, the trap should be conditioned for 10 min. at 180°C with backflushing. The trap may be vented to the analytical column during daily conditioning; however, the column must be run through the temperature program prior to analysis of samples.

6.10.3 The desorber should be capable of rapidly heating the trap to 180°C for desorption. The polymer section of the trap should not be heated higher than 180°C, and the remaining

sections should not exceed 220°C during bake-out mode. The desorber design illustrated in Figures 2 and 3 meet these criteria.

6.10.4 Another alternate trap uses 7.6 cm Carbopack B and 1.3 cm Carbosieve S-III (Supelco Cat# 2-0321R). This trap should be desorbed at 240°C and baked to 300°C.

6.10.5 The purge-and-trap device may be assembled as a separate unit or may be coupled to a gas chromatograph, as shown in Figures 4 and 5.

6.10.6 Trap Packing Materials

6.10.6.1 2,6-Diphenylene oxide polymer: 60/80 mesh, chromatographic grade (Tenax GC or equivalent).

6.10.6.2 Methyl silicone packing: OV-1 (3%) on Chromosorb-W, 60.80 mesh or equivalent.

6.10.6.3 Silica gel: 35/60 mesh, Davison, grade 15 or equivalent.

6.10.6.4 Coconut charcoal: Prepare from Barnebey Cheney, CA-580-26 lot #m-2649, by crushing through 26 mesh screen.

7. Reagents

7.1 Reagent Water: Carbon-filtered water purged with helium prior to use.

7.2 Gasoline Control Standards: One reference standard is API PS-6 gasoline, a characterized gasoline used in petroleum research. (Major components in Table 2). Other gasolines of similar composition can be used if they are thoroughly evaluated by the laboratory.

7.3 Gasoline Component Standard: The 10 component quantification standard which also serves as the quantification range (retention time window defining mix) standard. The components and concentration of the 10000 ug/mL stock solution are in Table 3. The standard is prepared by the procedures in 7.4 and 7.5.

7.4 Stock Standards: Prepare a stock standard for the individual gasoline component standards in methanol at approximately 20 mg/mL. The gasoline component standard should be prepared at the concentrations shown in Table 3. Also, a stock gasoline control standard should be prepared.

7.4.1 Place about 8 mL of methanol in a 10 mL tared ground-glass stoppered volumetric flask. Allow the flask to stand, unstoppered, for about 10 min. or until all alcohol-wetted surfaces have dried. Weigh the flask to the nearest 0.1 mg.

7.4.2 Using a 25 uL syringe, immediately add appropriate amounts of each gasoline component to the flask. The liquid must fall directly into the alcohol without contacting the neck of the flask. For the gasoline control standard (using a separate flask), immediately add approximately 125 uL of gasoline to the flask; then reweigh.

7.4.3 Dilute to volume, stopper, and then mix by inverting the flask three times. Calculate the concentration in micrograms per liter (ug/L) for either standard. When compound purity is assayed to be 96% or greater, the volume may be used without correction to calculate the concentration of the stock standard. Commercially prepared stock standards may be used at any concentration if they are certified by the manufacturer or by an independent source.

7.4.4 Transfer the stock standard solution into a Teflon-sealed screw-cap/crimp cap bottle. Store, with minimal headspace, at -10°C to -20°C and protect from light.

7.4.5 Standards must be replaced after 6 months, or sooner if comparison with check standards indicates a problem.

7.5 Calibration Standards: Calibration standards at a minimum of five concentration levels are prepared in reagent water from the stock standards. One of the concentration levels should be at a concentration near the method detection limit. The remaining concentration levels should correspond to the expected range of concentrations found in real samples or should define the working range of the GC. See 9.3.2.

7.6 Internal Standard: Due to potential interferences, the internal standard is not recommended for FID quantification.

7.7 Surrogate Control Standard (SCS): The analyst should monitor both the performance of the analytical system and the effectiveness of the method of dealing with each sample matrix by spiking each sample, standard, and reagent water blank with one or two surrogate compounds, bromofluorobenzene or trifluorotoluene. Prepare a surrogate spiking solution at 250 ug/mL of the surrogate in methanol. Add 1.0 uL of this surrogate spiking solution directly into the 5 mL syringe with every water sample, low level soil and reference standard analyzed. Surrogate spike solution is added to high level soil samples during the extraction step (see 9.5.1). Other appropriate surrogates may be used (i.e. Isopropyl Toluene).

7.8 Laboratory Control Sample (LCS) Standard: From the stock PS-6 gasoline standard or other appropriate gasoline control standards (Section 7.4), addition of the following amounts yields the indicated concentrations:

10 uL added to 100 uL water: 1 mg/L

0.5 uL added to 5 g soil: 1 mg/kg

8. Sample Collection, Preservation and Handling

8.1 Aqueous samples should be collected in triplicate without agitation and without headspace in contaminant-free glass 40 mL vials with Teflon-lined septa in the caps. The Teflon layer must contact the sample. Sample vials should contain 200 uL of 50% HCl as a preservative for aromatic analytes. Refrigerate samples at 4°C after collection.

8.2 Soil should be collected in a 4 oz. wide mouth glass jar with a Teflon-lined septa cap. The soil should be disturbed as little as possible and the containers filled as full as possible. Refrigerate all samples at 4°C after collection. Soils for GRO must be analyzed within 14 days of the date collected.

9. Procedure

9.1 Volatile compounds are introduced into the gas chromatograph by purge-and-trap. Purge-and-trap may be used directly on ground water samples. Soils and solids can be analyzed directly or by the methanol extraction procedure, depending upon level of contamination. It is highly recommended that all samples be screened prior to analysis. This screening step may be analysis of a solid sample's methanol extract (diluted), the headspace method (SW-846 Method 3810), or the hexadecane extraction and screening method (SW-846 Method 3820).

9.2 Gas Chromatography conditions (recommended)

9.2.1 Column 1: Set helium column flow to 10 mL/min. Set column temperature to 35°C for 10 min, then 4°C/min to 180°C, then 40°C/min to 220°C and hold for 12.75 min. Conditions may be altered to improve resolution of gasoline range organics.

9.2.2 Other columns-set GC conditions to meet the criteria in 6.1.2.2.

9.3 Calibration

9.3.1 Prepare final solutions containing required concentrations of calibration standards, including surrogate standards, directly in the 5 mL glass syringe. Add the aliquot of calibration solution directly to the reagent water in the glass syringe by inserting the needle through the syringe end. When discharging the contents of the microsyringe, be sure that the end of the syringe needle is well beneath the surface of the reagent water. Attach the 2-way syringe valve to the syringe and then inject the standard into the purge vessel through the two way valve. Proceed with purge-and-trap analysis procedure.

9.3.2 Run the gasoline component standard at a minimum of five concentration levels above the detection limits and covering the expected range of samples or the linear range of the instrument. For the FID quantification of a multicomponent product such as gasoline, the linear range is related to the areas of individual components.

9.3.3 Inject each calibration standard utilizing the purge-and-trap. Tabulate area response for the ten components against mass injected. The results can be used to prepare a calibration curve for the detector. Alternately, the ratio of the amount injected to the response, defined as the calibration factor (CF), can be calculated for each analyte at each standard concentration. If the per cent relative standard deviation (%RSD) of the calibration factor is less than 25% over the working range, linearity through the origin can be assumed, and the calibration factor from the midpoint continuing calibration standard can be used in place of a calibration curve.

$$\text{Calibration Factor} = \frac{\text{Standard Amount (ng) Purged}}{\text{Total Area}}$$

9.3.4 The working calibration curve or calibration factor must be verified on each working day by the injection of a midpoint continuing calibration standard. If the response for the method standard varies from the predicted response by more than 25% a new calibration curve must be prepared.

$$\text{Percent Difference} = \frac{\text{CF1} - \text{CF2}}{\text{CF avg.}} \times 100$$

where:

CF1=Average calibration from the calibration curve.

CF2=Calibration factor from the midpoint continuing calibration

$$\text{CF avg.} = (\text{CF1} + \text{CF2}) / 2$$

9.4 Retention Time Window and Pattern Recognition

9.4.1 Before establishing windows, be certain that the GC system is within optimum operating conditions. Make three injections of the gasoline component standard throughout the course of a 72 hour period. Serial injections over less than a 72 hour period result in retention time windows that are too tight.

9.4.2 Calculate the standard deviation of the three absolute retention times for each method standard component.

9.4.2.1 The retention time window for individual peaks is defined as plus or minus three times the standard deviation of the absolute retention time for each component. For multiresponse petroleum products, the analyst may use the retention time window but should primarily rely on pattern recognition.

9.4.2.2 In those cases where the standard deviation for a particular analyte is zero, the laboratory should use ± 0.05 min as a retention time window.

9.4.3 The Laboratory must calculate retention time windows for each standard on each GC column and whenever a new GC column is installed. The data must be retained by the laboratory.

9.4.4 Other organic compounds, including chlorinated solvents, ketones and ethers are measurable by this method and will be reported as gasoline range organics.

9.4.5 Note: Although the retention time window definition (2-methylpentane to 1,2,4-trimethylbenzene) introduces a bias, it improves precision and reduces interferences from petroleum products other than gasoline.

9.5 Gas Chromatograph Analysis

9.5.1 Water Samples: Introduce volatile compounds into the gas chromatograph using the purge-and-trap method. Add 1.0 μ L of surrogate standard to the sample prior to purging.

9.5.1.2 Remove the plunger from a 5 mL syringe and attach a closed syringe valve. Open the sample or standard bottle, which has been allowed to come to ambient temperature, and carefully pour the sample into the syringe plunger and compress the sample. Open the syringe valve and vent any residual air while adjusting the sample volume to 5.0 mL. This process of taking an aliquot destroys the validity of the liquid sample for future analysis; therefore, if there is only one 40 mL vial, the analyst should fill a second syringe at this time to protect against possible loss of sample integrity. This second sample is maintained only until such time when the analyst has determined that the first sample has been analyzed properly. Filling one 5 mL syringe would allow the use of only one syringe. If a second analysis is needed from a syringe, it must be analyzed within 24 hours. Care must be taken to prevent air from leaking into the syringe.

9.5.1.3 The following procedure is appropriate for diluting purgeable samples. All steps must be performed without delays until the diluted sample is in a gas-tight syringe.

9.5.1.4 Dilutions may be made in volumetric flasks (10 mL to 100 mL). Select the volumetric flask that will allow for the necessary dilution. Intermediate dilutions may be necessary for highly concentrated samples.

9.5.1.5 Calculate the approximate volume of reagent water to be added to the volumetric flask selected and add slightly less than this volume of reagent water to the flask.

9.5.1.6 Inject the proper aliquot of samples from the syringe prepared in Paragraph 9.5.1.2 into the flask. Aliquots of less than 1 mL are not recommended. Dilute the sample to the mark with reagent water. Cap the flask, invert and shake three times. Repeat the above procedure for additional dilutions. Alternately the dilutions can be made directly in the glass syringe to avoid further loss of volatiles.

9.5.1.7 Fill a 5 mL syringe with diluted sample as in Paragraph 9.5.1.2.

9.5.1.8 Add 1.0 uL of surrogate spiking solution through the valve bore of the syringe; then close the valve.

9.5.1.9 Attach the syringe-syringe valve assembly to syringe valve on the purging device. Open the syringe valves and inject sample into the purging chamber.

9.5.1.10 Close both valves and purge the sample for 12 min.

9.5.1.11 At the conclusion of the purge time, attach the trap to the chromatograph, adjust the device to the desorb mode, and begin the gas chromatographic temperature program and GC data acquisition. Concurrently, introduce the trapped materials to the gas chromatographic column by rapidly heating the trap to 180°C and backflushing the trap with inert gas between 20 and 60 mL/min for 4 minutes.

9.5.1.12 While the trap is desorbing into the gas chromatograph, empty the purging chamber. Wash the chamber with minimum of two 5 mL flushes of reagent water (or methanol followed by reagent water) to avoid carryover of pollutant compounds into subsequent analyses.

9.5.1.13 After desorbing the sample, recondition the trap by returning the purge-and-trap device to the purge mode. Wait 15 sec; then close the syringe valve on the purging device to begin gas flow through the trap. The trap temperature should be maintained at 180°C. Trap temperatures up to 220°C may be employed; however, the higher temperature will shorten the useful life of the trap. After approximately 7-35 min, turn off the trap heater and open the syringe valve to stop the gas flow through the trap. When cool, the trap is ready for the next sample.

9.5.1.14 If the initial analysis of a sample or a dilution of the sample has a concentration of analytes that exceeds the initial calibration range, the sample must be reanalyzed at a higher dilution. When a sample is analyzed that has a saturated response from a compound, this analysis must be followed by a blank reagent water analysis. If the blank analysis is not free of interferences, the system must be decontaminated. Sample analysis may not resume until a blank can be analyzed that is free of interferences.

9.5.1.15 All dilutions should keep the response of the major constituents (previously saturated peaks) in the upper half of the linear range of the curve.

9.5.2 Sediment/soil samples: It is highly recommended that all samples of this type be screened prior to the purge-and-trap GC analysis. These samples may contain percent quantities of purgeable organics that will contaminate the purge-and-trap system, and require extensive cleanup and instrument downtime. See 9.1 for recommended screening techniques. Use the screening data to determine whether to use the low-level method or the methanol extraction technique.

9.5.2.1 Low-level method: This is designed for samples containing low level petroleum products. It is limited to sediment/soil samples and waste that is of a similar consistency. The low-level method is based on purging a soil sample mixed with reagent water containing the surrogate and, if applicable, internal, surrogate and matrix spiking standards. Analyze all reagent blanks and standards under the same conditions as the samples.

9.5.2.1.1 Weigh out a 5-g sample into a purge device. Add reagent water to the purge device, cap and agitate. Add 0.5 uL of the surrogate solution to the purge device containing the sample and connect the device to the purge-and-trap system. These steps must be performed in rapid succession to avoid loss of volatiles.

9.5.2.1.2 Purge the sample 12 min. and then proceed as in 9.5.1.11 through 9.5.1.15.

9.5.3 Methanol Extraction for High Level Soil/Sediment: Weigh 10 g (wet weight) of sample into a tared 20 mL vial, using a top-loading balance. Note and record the actual weight to 0.1 gram. Quickly add 10 mL of methanol to the vial. Cap and shake for 2 min. These procedures must be performed rapidly and without interruption to avoid loss of volatile organics.

9.5.3.1 Allow sediment to settle, centrifuge if necessary. Pipet approximately 1 mL of the extract to a GC vial for storage, using a disposable pipet. The remainder may be disposed. If not analyzed immediately, these extracts must be stored at 4°C in the dark.

9.5.3.2 The GC system should be set up as in Section 9.0. This should be performed prior to the addition of the methanol extract to reagent water.

9.5.3.3 If a screening procedure was followed, use the estimated concentration to determine the appropriate volume of methanol extract. The maximum volume of methanol is 100 uL per 100 mL of reagent water. This is due to the need to separate cleanly the methanol front from the defined retention time window of the gasoline range organics.

9.5.3.4 Calculate the approximate volume of reagent water to be added to the 100 mL volumetric flask and add slightly less than this volume of reagent water to the flask.

9.5.3.5 Inject the proper amount of extract prepared in 9.5.3 into the flask. Dilute the sample to the mark with reagent water. Cap the flask, invert and shake three times.

9.5.3.6 Follow the procedures outlined for a dilution of a water sample as in 9.5.1.7 through 9.5.1.15. Analyze all reagent blanks on the same instrument as that used for the samples. The reagent blank should contain an aliquot of the methanol used to extract the sample.

9.5.4 Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration followed by sample extracts interspersed with continuing calibration standards. The sequence ends when the set of samples has been injected or when qualitative and/or quantitative QC criteria are exceeded.

9.5.5 If the responses exceed the linear range of the systems, use a smaller amount of sample.

9.5.6 The calibration factor for the gasoline range organics must not exceed +/-25% when compared to the initial standard of the analysis sequence. When this criteria is exceeded, inspect the GC necessary prior to recalibration and proceeding with sample exceeding QC criteria must be reanalyzed.

9.6 Calculations

9.6.1 The concentration of Gasoline Range Organics in the sample is determined by calculating the absolute weight of analyte purged, from a summation of peak response for all chromatographic peaks eluting between 2-methylpentane and 1,2,4-trimethylbenzene, using the calibration curve or calibration factor determined in 9.3.3. Refer to 9.4 (Retention Time Windows and Pattern Matching). The concentration of Gasoline Range Organics is calculated as follows:

Aqueous or soil samples:

$$Cs \text{ (ng/mL or ng/g)} = \frac{AX}{Vs \text{ or } Ms} \times CF \times D$$

Where:

Cs = Concentration of Gasoline Range Organics.

Ax = Response for the Gasoline Range Organics in the sample, units in area.

CF = Calibration Factor from continuing calibration, units = ng/area.

D = Dilution factor, if dilution was performed on the sample prior to analysis. If no dilution was made, D=1, dimensionless.

Vs = Volume of sample purged, mL.

Ms = Mass of sample purged, g.

10. Quality Control

10.1 The laboratory must, on an ongoing basis, demonstrate through the analysis of quality control check standards that the operation of the measurement system is in control. This should include the analysis of QC check samples plus the calculation of average recovery and the standard deviation of the recovery as outlined in Method 8000, Section 8.0.

10.2 After successful calibration (Section 9.3), analyze a Surrogate Control Sample. This standard is also the reagent blank sample and is analyzed with every analytical batch or sequence. The surrogate recovery should be within established limits (Table 4) and the sample should not have Gasoline Range Organics above the practical qualification limit.

10.3 Every batch or 20 samples, duplicate Laboratory Control Samples must be analyzed. The accuracy and precision of the Duplicate standards must be within established limits. (Table 4).

10.4 If any of the criteria in 10.2 and 10.3 are not met, the problem must be corrected before samples are analyzed.

10.5 Calculate surrogate standard recovery in each sample. If recoveries are outside established limits, verify calculations, dilutions, and standard solutions. Verify instrument performance.

10.5.1 High recoveries may be due to a coeluting matrix interference-examine the sample chromatography.

10.5.2 Low recoveries may be due to the sample matrix.

10.5.3. Low recoveries may be due to a poor purge (clogged purge tube). If this is suspected, reanalyze the sample while observing the purge tube.

10.6 Field blanks, duplicates and matrix spikes are recommended for specific sampling programs.

11. Method Performance

11.1 The average recovery of gasoline from water samples spiked with 1000ppb was 68% with a Relative Standard Deviation (RSD) of 20 (n=31). The average recovery of gasoline from sediments samples spiked with 1000ppb was 75% with a Relative Standard Deviation (RSD) of 24 (n=24).

12. References

1. USEPA "SW-846 Test Methods for Evaluating Solid Waste", 3rd Edition; Methods 5030, 8000, 8015, and 8030.
2. American Petroleum Institute "Sampling and Analysis of Gasoline Range Organics in Soils", in preparation.
3. "Evaluation of Proposed Analytical Methods to Determine Total Petroleum Hydrocarbons in Soil and Groundwater" prepared by Midwest Research Institute for USEPA Office of Underground Storage Tanks, August 14, 1990.
4. ASTM "Standard Practical For Sampling Waste and Soils For Volatile Organics" Draft #1, 2/16/87.
5. Parr, J.L., G. Walters, and M. Hoffman, "Sampling and Analysis of Soils for Gasoline Range Organics" presented at First Annual West Coast Conference Hydrocarbon Contaminated Soils and Groundwater, 2/21/90.
6. American Petroleum Institute "Laboratory Study on Solubilities of Petroleum Hydrocarbons in Groundwater", August, 1985, API Publ. 4395.
7. "Leaking Underground Fuel Tank (LUFT) Field Manual," State Water Resources Control Board, State of California, Sacramento, California, May, 1988.
8. Fitzgerald, John "Onsite Analytical Screening of Gasoline Contaminated Media Using a Jar Headspace Procedure" in Petroleum Contaminated Soils, Vol. 2, 1989.
9. Senn, R.B., and M.S. Johnson, "Interpretation of Gas Chromatographic Data in Subsurface Hydrocarbon Investigations," Ground Water Monitoring Review, 1987.
10. Hughes, B.M., D.E. McKenzie, C.K. Trang, L.S.R. Minor, "Examples of the Use of an Advanced Mass Spectrometric Data Processing Environment for the Determination of Sources of Wastes" in Fifth Annual Waste Testing and Quality Assurance Symposium; USEPA, July 24-28, 1989.
11. Urban, M.J., J.S. Smith, E.K. Schultz, R.K. Dickson, "Volatile Organic Analysis for a Soil, Sediment or Waste Sample" in Fifth Annual Waste Testing and Quality Assurance Symposium; USEPA, July 24-28, 1989.
12. Siegrist, R.L., and P.D. Jenssen, "Evaluation of Sampling Method Effects on Volatile Organic Compound Measurements in Contaminated Soils", Environmental Science and Technology, Vol. 24, November 9, 1990.

TABLE 1
PURGE AND TRAP OPERATING PARAMETERS

METHOD	ANALYSIS
	8020

Purge gas		Nitrogen or Helium
Purge gas flow rate (mL/min)		20-40
Purge time (min)	12.0 +/-0.1	
Purge temperature		Ambient
Desorb temperature (°C)	180	
Backflush inert gas flow mL/min)	20-60	
Desorb time		4

TABLE 2
MAJOR COMPONENTS OF API PS-6 GASOLINE

Compound	Percent Weight	
2-Methylbutane	8.72	
m-Xylene		5.66
2,2,4-Trimethylpentane	5.22	
Toluene		4.73
2-Methylbutane	3.93	
n-Butane		3.83
1,2,4-Trimethylbenzene	3.26	
n-Pentane		3.11
2,3,4-Trimethylpentane	2.99	
2,3,4-Trimethylpentane	2.85	
3-methylpentane	2.36	
o-Xylene		2.27
Ethylbenzene		2.00
Benzene		1.94
p-Xylene		1.72
2,3-Dimethylbutane	1.66	
n-Hexane		1.58
1-Methyl, 3-ethylbenzene	1.54	
1-Methyl, 4-ethylbenzene	1.54	
3-Methylhexane		1.30

Reference (6)

TABLE 3
GASOLINE COMPONENT STANDARD AND CONCENTRATIONS

Component	Concentration, (ug/mL)
2-Methylpentane	1500

2,2,4-Trimethylpentane	1500	
Heptane	500	
Benzene	500	
Toluene	1500	
Ethylbenzene	500	
m-Xylene	1000	
p-Xylene	1000	
o-Xylene	1000	
1,2,4-Trimethylbenzene	<u>1000</u>	
		10000 ug/mL T

TABLE 4
ACCEPTANCE CRITERIA FOR LABORATORY QUALITY CONTROL CHECKS

Analyte	Spike Concentration		Control Limits
Relative			
<u>Laboratory Control Sample</u>	<u>Water mg/L</u>	<u>%Rec</u>	<u>%Difference</u>
Gasoline Range Organics	1.0	50-100	20
<u>Surrogate Control Sample</u>			
Isopropyltoluene	0.05	50-150	

SECTION 3.7

DISPOSAL OF PETROLEUM CONTAMINATED MEDIA

SECTION 3.7

DISPOSAL OF CONTAMINATED MEDIA

The purpose of the following is to establish the criteria which must be met in order for soil or debris which has been contaminated with petroleum products (e.g. gasoline, diesel, kerosene, fuel oils) to be approved for disposal only in a Subtitle D Landfill in Tennessee. Such contaminated soil or debris is considered a "special waste" under Tennessee Rule Chapter 1200-1-7, Solid Waste Processing and Disposal, and may not be disposed in a landfill in Tennessee unless approved by this Division in writing pursuant to Rule 1200-1-7-.01(4).

CRITERIA FOR DISPOSAL OF PETROLEUM CONTAMINATED SOIL AND DEBRIS IN A SUBTITLE D LANDFILL

All petroleum contaminated soil and debris which is to be disposed in a Subtitle D landfill is required to have Special Waste Approval from the Division. To apply for Special Waste Approval, a Waste Evaluation Application must be submitted to the Division together with a fee of \$250.00. (Applicable analytical data requested in the Application must also be submitted.) All petroleum contaminated soil and debris must be sampled and subjected to analysis for the hazardous constituents of benzene and lead, and if the presence of benzene or lead is detected, a TCLP analysis must be performed with the results not to exceed the maximum concentration limits (mcls) as set forth in 40 CFR 261.24, incorporated by reference at subparagraph (3)(a) of Tennessee Rule Chapter 1200-1-11.02 (see chart below for TCLP mcls). Soils contaminated solely from vehicle accidents in which only diesel fuel is involved shall not be required to be analyzed, however a Special Waste Approval is still required. If Benzene and lead are not detected in the samples, a TCLP analysis of the samples is not required. **Since TPH alone (diesel, kerosene and fuel oils) is not a regulated hazardous waste, the Division no longer requires that petroleum contaminated soil and debris be analyzed for TPH contamination and there is no TPH concentration limit for disposal in a Subtitle D landfill. The general prohibition of "no free liquids" is applicable. However, soil and debris that is contaminated solely by TPH is still required to be analyzed for the presence of benzene and lead.**

CONTAMINANT	TEST METHOD	MCL (PPM)
BENZENE	TCLP	0.5
LEAD	TCLP	5.0

For soil and debris that cannot be verified to be exclusively contaminated with petroleum hydrocarbons it may be appropriate to analyze the TCLP extract for additional toxic constituents or the waste itself for one or more hazardous waste characteristics (e.g., reactivity). In some situations, it may also be appropriate to test the soil or debris for PCB concentrations. Soil and debris containing concentrations above the listed 40 CFR 261.24 maximum concentration limits from TCLP analysis are not eligible for disposal in a sanitary landfill. The Division may also require that confirmatory sampling be performed in the area from which the petroleum

contaminated soils were removed. A description of acceptable analytical methods for the most common petroleum contaminants is as follows:

Analytical Methods

- A. TCLP Test - The Toxicity Characteristic Leaching Procedure to be performed is that established for hazardous waste in 40 CFR, Part 261, Appendix II.
 - 1. Benzene - benzene concentrations in the TCLP extract are to be determined using:
 - a. EPA Methods 8020 or 8240 from EPA Publication SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (Third Edition); or,
 - b. an equivalent test method deemed acceptable by DSWM staff.
 - 2. Lead - Lead concentrations in the TCLP extract are to be determined using:
 - a. EPA Methods 6010, 7420 or 7421 from EPA Publications SW-846; or,
 - b. an equivalent test method deemed acceptable by DSWM staff.

SECTION 3.8
REPORTING REQUIREMENTS

SECTION 3.8

REPORTING REQUIREMENTS

Numerous inquiries from environmental consultants, attorneys and facilities regarding reporting requirements for the State of Tennessee have prompted the need for policy clarification on this issue in order to insure consistent responses from DSWM staff when answering questions concerning this issue. The following is a brief summary of the Department's position on reporting requirements according to Mr. Joe Sanders, Office of General Counsel:

1. Although the State of Tennessee has no affirmative statute regarding reporting requirements, it is illegal in the State of Tennessee to own/operate an unpermitted disposal site, and upon the State's discovery, the owners of the facility upon which the disposal is discovered can be subject to penalties up to \$50,000.00 per day from the date of discovery. This means that soil and/or groundwater contamination that is discovered at an unpermitted site should be reported to the State on the basis that an illegal disposal exists at the site and if not reported, could be subject to substantial monetary penalties and possible enforcement action by the Division.
2. CERCLA has specific reporting requirements, and the State of Tennessee maintains that a facility has an obligation to report any disposal to the EPA, who in turn will report it to the State of Tennessee. The toll free number for facilities to report to the EPA is 1-800-424-8802.

In summary, the Division maintains that if the owners of a facility discover the existence of an illegal disposal at their site, such disposal should be reported immediately.

SECTION 3.9

EVALUATION PROCESS FOR SITES ENTERING LONGTERM MONITORING OR REMEDIATION

SECTION 3.9

EVALUATION PROCESS FOR SITES ENTERING LONG-TERM GROUNDWATER MONITORING OR REMEDIATION

The following is a guide for the evaluation process used by the State Remediation Program (SRP) when determining when or if a site has been brought to the point where decisions concerning either long-term remediation, groundwater monitoring or no further action can be made. At the point at which the Project Manager decides that enough data has been generated at the site to verify that the contaminate plume in soil and/or groundwater has been adequately defined both vertically and horizontally, a peer review meeting (consisting of the Project Manager, Program Manager for the SRP, Assistant Program Manager for the SRP, with at least one of these persons having a background in geology) should be scheduled. At this meeting, the Project Manager will brief those in attendance on the current status of the site and after a general review of analytical data and discussion of site history, a decision will be issued by the Program Manager or his designee as to which of the following shall be utilized in proceeding with the site:

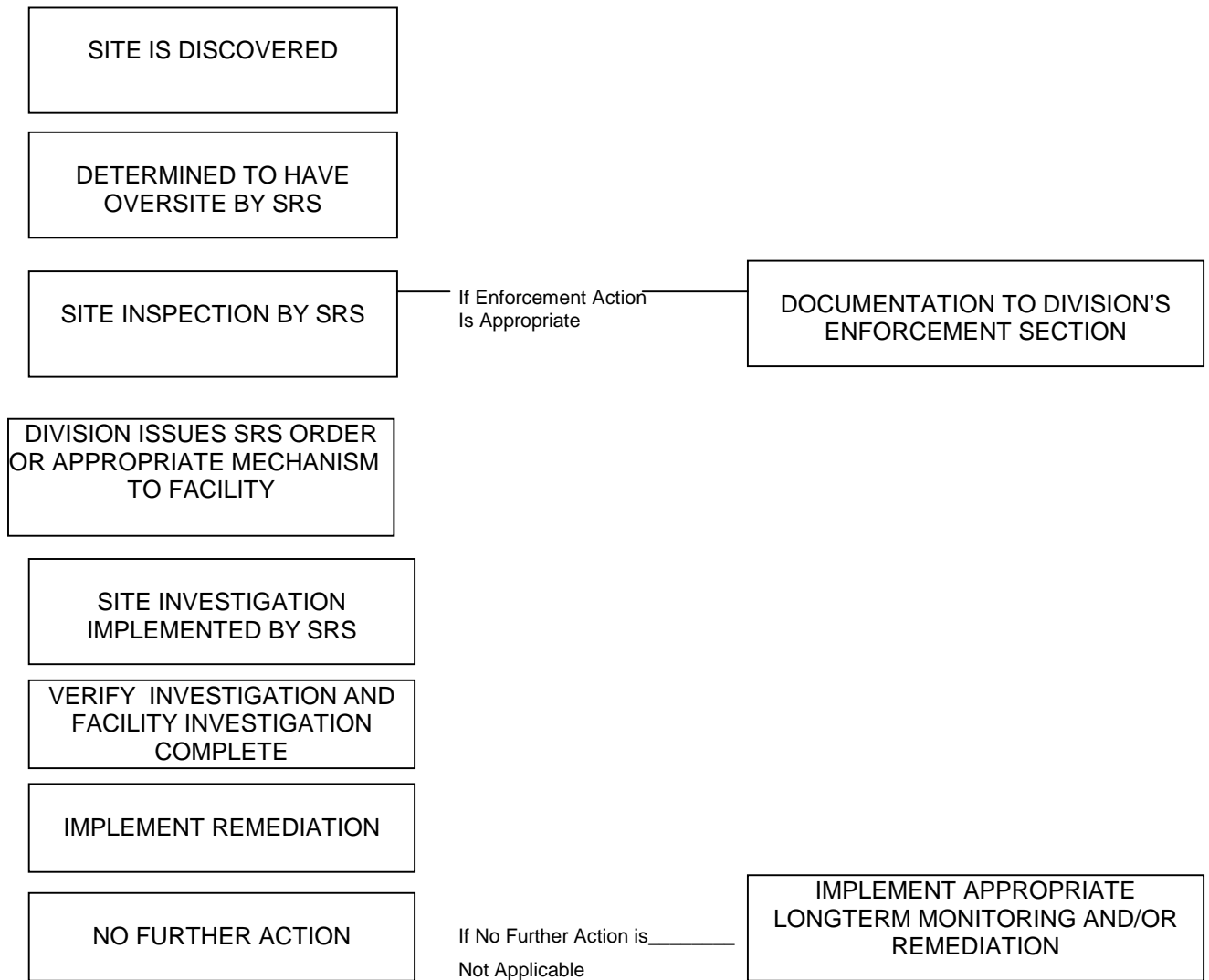
1. Long term monitoring - may be utilized when the plume is confined roughly to site boundaries and does not pose a threat to residents and/or the environment. (This may also be used as an evaluation tool when used for a specified time to ascertain if plume is naturally attenuating).
2. Remediation - may be utilized when contaminant concentrations at the site pose a threat to residents and/or the environment, either by high concentrations or by movement of the contaminant plume off-site. Methods of remediation will be determined on a site-by-site basis.
3. Groundwater Classification-may be utilized when a facility wants to obtain closure, but the groundwater contains contaminants (not related to petroleum hydrocarbon contamination) at concentrations exceeding the State's groundwater quality criteria for drinking water. (Please see Rule 1200-4-3-.07 – Groundwater Classification)
3. No Further Action - utilized when contaminant concentrations pose no threat to residents or the environment and the State determines that there is no further

need for additional remediation or monitoring. Depending on site conditions, one of the above or a combination may be utilized to complete the site work.

SECTION 4

PROCESS FLOW DIAGRAM

SECTION 4
PROCESS FLOW DIAGRAM



STEP-BY-STEP PROCEDURE FOR SITE MANAGEMENT BY THE SRS

Once it has been determined that a site will have SRP oversight, the following steps are generally followed until a site is issued a “no further action” letter.

ADMINISTRATIVE

The following should be performed at the beginning of facility oversight:

1. Site must be:
 - a. issued an SRP number
 - b. entered on the Site Activity Log
 - c. placed on the EXCEL sortable list
 - d. issued either a Remediation Notice or Remediation Order, unless Program Manager approves otherwise

SITE INVESTIGATION AND REMEDIATION

The SRP uses a phased approach when managing sites. Each phase of the investigation will require submittal of a workplan outlining activities necessary to attempt to delineate the vertical and horizontal extent of the contaminate plume. An SRP project manager will review the workplan and either approve it or make suggestions as to how to improve it. After completion of the workplan activities, a final report will be submitted by the facility to the SRP project manager for evaluation. If the plume has not been adequately defined, another phase of investigation will be required of the facility, necessitating submittal of another workplan to the SRP for approval.

Once the SRP project manager is satisfied that the contaminant plume has been adequately defined, one of the following will be chosen as the next step:

1. Remediation of the site will be required (excavation, pump-and-treat, vapor extraction, etc.).
2. A “monitor only” status is granted (submittal of quarterly or semi-annual soil and/or groundwater sample analysis to this office is required).
3. No further action (site is taken off of SRP active list)

4. Groundwater Classification is utilized (for sites unable to remediate groundwater to drinking water standards and would like to obtain closure from the Division. Petroleum contaminated groundwater is exempt from this procedure.) Please see Rule 1200-4-3-.07 (Groundwater Classification)

Prior to choosing one of the above steps, a peer review meeting (consisting of the project manager, SRP Program Manager and Assistant Program Manager, with at least one of these persons having a background in geology) shall be scheduled. Project Manager shall brief those in attendance on site status, and after review of site history and analytical data, a decision will be issued by the Program Manager or his designee as to which mechanism should be utilized as the next step. Project Manager should then correspond with the facility in writing, advising them of how next to proceed.

If a facility is required to remediate a site, a workplan detailing proposed type of remediation should be submitted to the SRP for review. Upon approval from the SRP, remediation activities can be initiated at the facility. A final report must be submitted to the SRP for evaluation after remediation activities are completed. If the objectives of the remediation workplan have been met, and no further remediation is necessary, after approval is given in a peer review meeting, a “no further action” or a “monitor only” status can be granted.

When a facility is given a “monitor only” status, a facility will be required to monitor the soil and/or groundwater either on a quarterly or semi-annual basis, and submit sample results to the SRP for review. When it is determined that contaminant levels have reached acceptable (non-detect, asymptotic, etc.) concentrations for closure, a no further action may be granted by the project manager, after approval is given in peer review meeting.

When a facility elects to pursue a “Groundwater Classification”, the facility must follow the procedures outlined in Rule 1200-4-3-.07 for the classification selection and procedure. Technical Guidance to implement this rule is currently being developed by the Department and will be added to the State Remediation Program’s Standard Operating Procedures as soon as it is available.

SITE ACTIVITY LOG (S.A.L.)

The Site Activity Log is a tracking mechanism that will be a part of the State’s data banks. It logs all pertinent activity at a facility having oversight by the SRP. Each project manager is responsible

for entering this information on the Site Activity Log for sites they are managing. Examples of information that should be included on the Site Activity Log are:

1. location of site and name of project manager
2. date of issue for Remediation Orders or Notices of Remediation
3. dates of correspondence, when sent or received
4. dates Workplans or Reports are received
5. dates of meetings or site visits

CHECKLIST FOR SITE MANAGEMENT

<u>PROCEDURE</u>	<u>TASK COMPLETED</u>
1. SRP number issued	_____
2. Entered on SAL	_____
3. Entered on EXCEL List	_____
4. Issuance of Notice or Remediation Order	_____
5. Submittal and review of Workplan(s)(once cost recovery assessments have been paid)	_____
6. Approval of Workplan(s)	_____
7. Submittal and review of Report(s)(Upon payment of Cost Recovery Assessments)	_____
8. Contaminant plume defined vert. and horiz.	_____
9. Peer review meeting(s)	_____
10. Grant "monitor only" status	_____
11. Require remediation	_____
12. Grant "no further action"	_____
13. Received certification of <u>site wide</u> assessment for aoc	_____
14. Utilizing Groundwater Classification Procedure	_____

SECTION 5

SITE ACTIVITY LOG

***The Site Activity Log is not available on diskette, but will be available on the State of Tennessee's computer data banks in the near future.**

APPENDICES

APPENDIX 1. MAY 1, 1996 EPA PROPOSED RULE 61-FR19432

APPENDIX 2. HERMAN / LAWS LETTER (9-24-96)

**APPENDIX 3. COMPLETE COPY OF MEMORANDUM OF AGREEMENT
BETWEEN STATE OF TN. AND EPA**

***The appendices are not available on diskette but may be ordered from the State
Remediation Section by calling 1-615-532-0869.**

